# TM 11-2095

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

# TRANSMISSION MEASURING SET TS-568/FT

*DEPARTMENT OF THE ARMY* • *JANUARY 1951*

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*DEPARTMENT OF THE ARMY* • *JANUARY 1951*

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# CHAPTER 1

# INTRODUCTION

## Section I. GENERAL

### 1. Scope

These instructions are published for the information and guidance of the personnel to whom this equipment is issued. They contain information on the operation and organizational maintenance of the equipment as well as a description of its function in relation to other equipment with which it is used. They apply only to Transmission Measuring Set TS–568/FT.

### 2. Appendixes

This manual contains four appendixes: Appendix I includes tables; appendix II is devoted to references to other sources of information; appendix III is an identification table of parts; appendix IV is the glossary.

### 3. Forms and Records

The following standard forms will be used for reporting unsatisfactory conditions of equipment, or improper preservation, packaging, packing, marking, loading, stowage, or handling thereof.

*a.* DD Form 6, Report of Damaged or Improper Shipment (Reports Control Symbols CS GLD–66), will be filled out and forwarded as prescribed in SR 745–45–5.

*b.* DA AGO Form 468, Unsatisfactory Equipment Report (Reports Control Symbol CS GLD–247) will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

*c.* Use other forms and records as authorized.

## Section II. DESCRIPTION AND DATA

### 4. Description of Transmission Measuring Set TS-568/FT

*a.* Transmission Measuring Set TS–568/FT (fig. 1) is used with Transmission Measuring Set TS–559/FT. Transmission Measuring Set TS–568/FT will be referred to in this manual as the TS–568/FT and Transmission Measuring Set TS–559/FT will be referred to as the TS–559/FT.

*b.* The combination of the TS–568/FT and the TS–559/FT is used for frequency and amplitude analyses of noise currents and voltages induced on telephone circuits and for measurements of harmonic currents and voltages on power circuits. While the TS–568/FT is designed particularly for use with the TS–559/FT, it may be used with any amplifier-indicator having similar input impedance and gain characteristics.

*c.* The combination of TS–568/FT and TS–559/FT provides a visual indicating arrangement for measurements of the harmonic components, between 180 and 4,000 cps, of the noise-metallic or noise-to-ground on telephone circuits. In conjunction with Voltage Analyzer Compensator CN–140/TT and Current Analyzer Compensator CN–141/TT, the combination of TS–568/FT and TS–559/FT is suitable for harmonic analyses of power circuit currents and voltages. Also, noise Kv.T and I.T products can be measured without changes in the external wiring of the apparatus.

## 5. Component Parts

*a.* Transmission Measuring Set TS–568/FT is contained in a single metal case with cover; the case is approximately 9 inches deep by 8 inches high by 14 inches wide and weighs about 25 pounds (fig. 2).

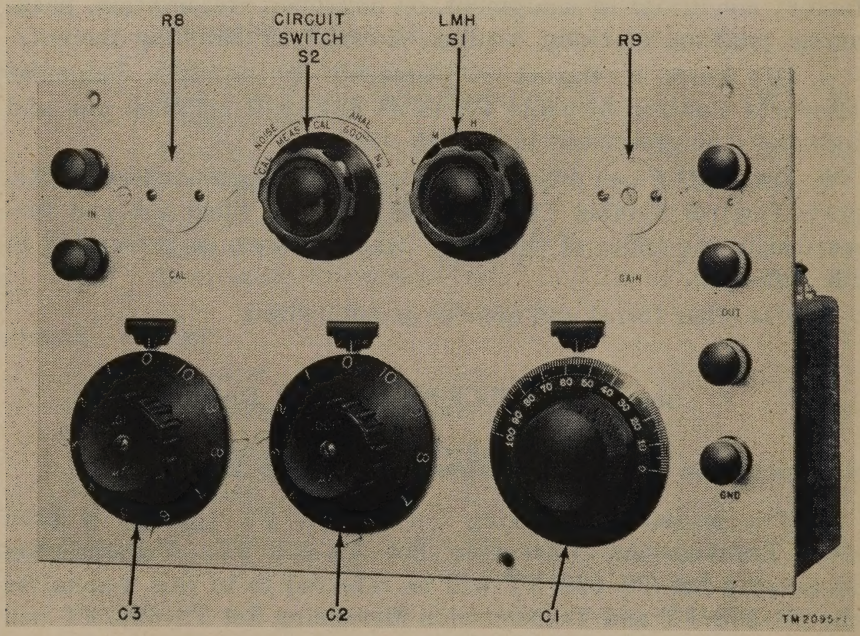



*Figure 1. Transmission Measuring Set TS–568/FT, panel view.*

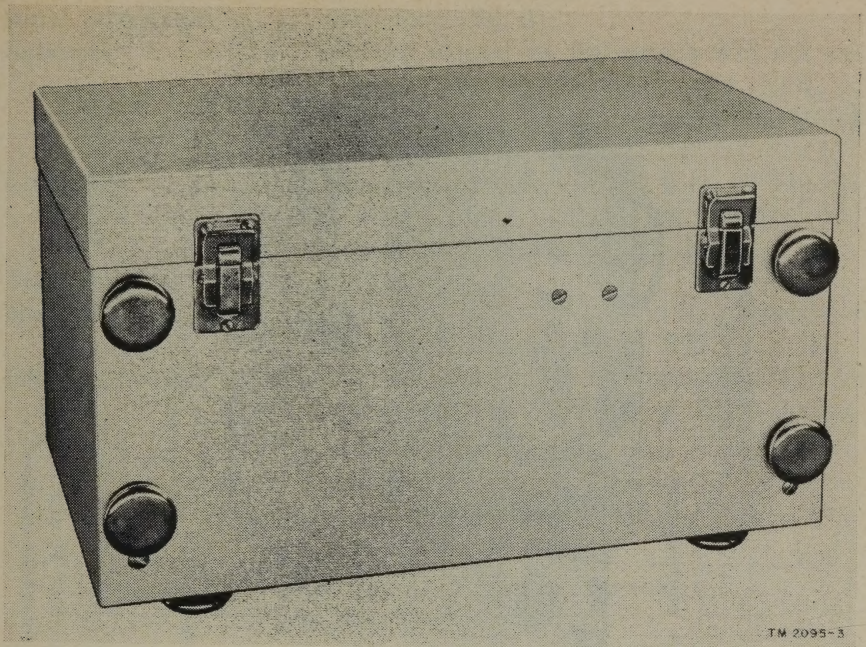



*Figure 2. Transmission Measuring Set TS–568/FT, case, front view.*

*b.* All components, binding posts, and controls are mounted on the front panel which is removable from the case.

## 6. Accessory Equipment

*a.* Transmission Measuring Set TS–568/FT has been designed as an adjunct to Transmission Measuring Set TS–559/FT.

*b.* The Voltage Analyzer Compensator CN–140/TT and Current Analyzer Compensator CN–141/TT also are required if it is desired to make harmonic analyses of power circuit currents and voltage.

## 7. Technical Characteristics

The characteristics of Transmission Measuring Set TS–568/FT follow:

Frequency range ..... 180 to 4,000 cps available in three steps, L, M, and H.

Selectivity .....

| Range | Freq range (cps) | Freq response 60 cps away (db) | Freq response 120 cps away (db) |
|---|---|---|---|
| Low | 180–540 | —24 | —30 |
| Medium | 540–1,500 | —20 | —25 |
| High | 1,500–3,000 | —16 | —21 |

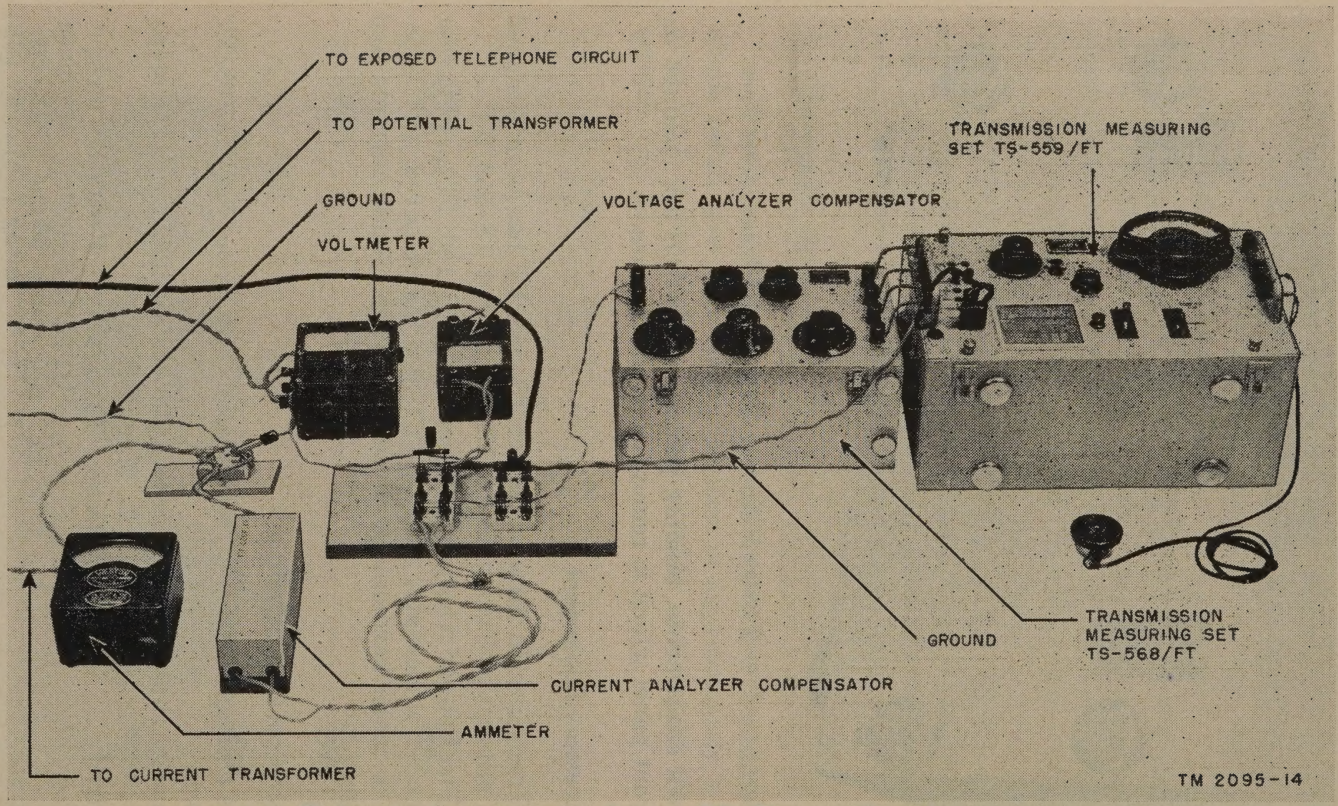



*Figure 3. Connections of TS–568/FT, TS–559/FT, and analyzer compensators for tests of power and telephone circuits.*

Input impedance_____600 ohms (fig. 4).

Balance_____Errors caused by unbalance will not exceed .03 microampere per volt to ground at 3,000 cps for metallic-circuit current measurement.

Linearity_____Maximum error is about 2 db at 540 cps on low range (fig. 5) for a decibel dial setting of 75 on TS–559/FT.

Testing range_____See table I.

Modulation_____180-cyc generation caused by presence of 60 cps will not exceed .2%.

Effect of temperature___Errors caused by temperature change between 30° F. and 100° F. do not exceed 1 db (fig. 6).

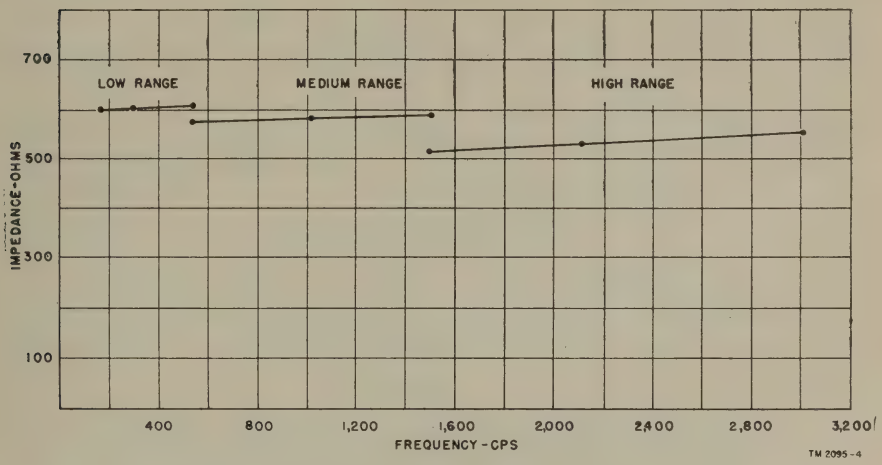



*Figure 4. Input impedance of 600-ohm input circuit.*

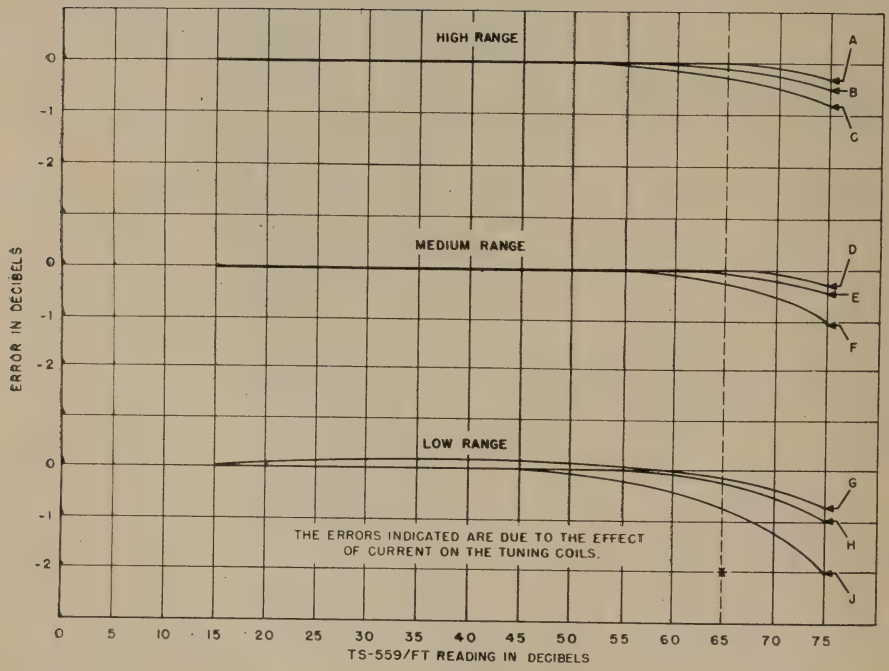
## 8. Packaging Data

*a.* Transmission Measuring Set TS–568/FT, packed for shipment, is cased in a wooden box which meets the requirements of Joint Army-Navy specifications as described in JAN–P–100 and JAN–P–116.

*b.* Dimensions and weight of packaged equipment follow:

| Height (in.) | Width (in.) | Depth (in.) | Volume (cu ft) | Weight (lb) |
|---|---|---|---|---|
| 14¼ | 23 | 14¼ | 2.7 | 60 |

*c.* For details of unpacking and repacking, see paragraphs 9 and 44.




CIRCUITS

| | | A | B | C | D | E | F | G | H | J |
|---|---|---|---|---|---|---|---|---|---|---|
| FREQ. | | 1,500 | 2,100 | 3,000 | 540 | 1,020 | 1,500 | 180 | 300 | 540 |
| 600 OHMS MICROAMPS | | 71 | 78 | 95 | 200 | 210 | 215 | 925 | 900 | 975 |
| $10^5$ OHMS VOLTS | | 7.1 | 7.8 | 9.5 | 20 | 21 | 21 | 90 | 90 | 100 |
| COMPENSATORS | I TIF AMP | 0.022* | 0.018 | 0.016 | 0.18 | 0.10 | 0.07 | 2.3 | 1.40 | 0.90 |
| | V TIF VOLTS | 1.4 | 1.1 | 1.0 | 11.5 | 6.4 | 4.6 | 160 | 95 | 60 |

* TABLE INDICATES APPROXIMATE VALUES FOR READING OF 65 DB

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*Figure 5. Linearity of measurements made with Transmission Measuring Set TS–568/FT.*

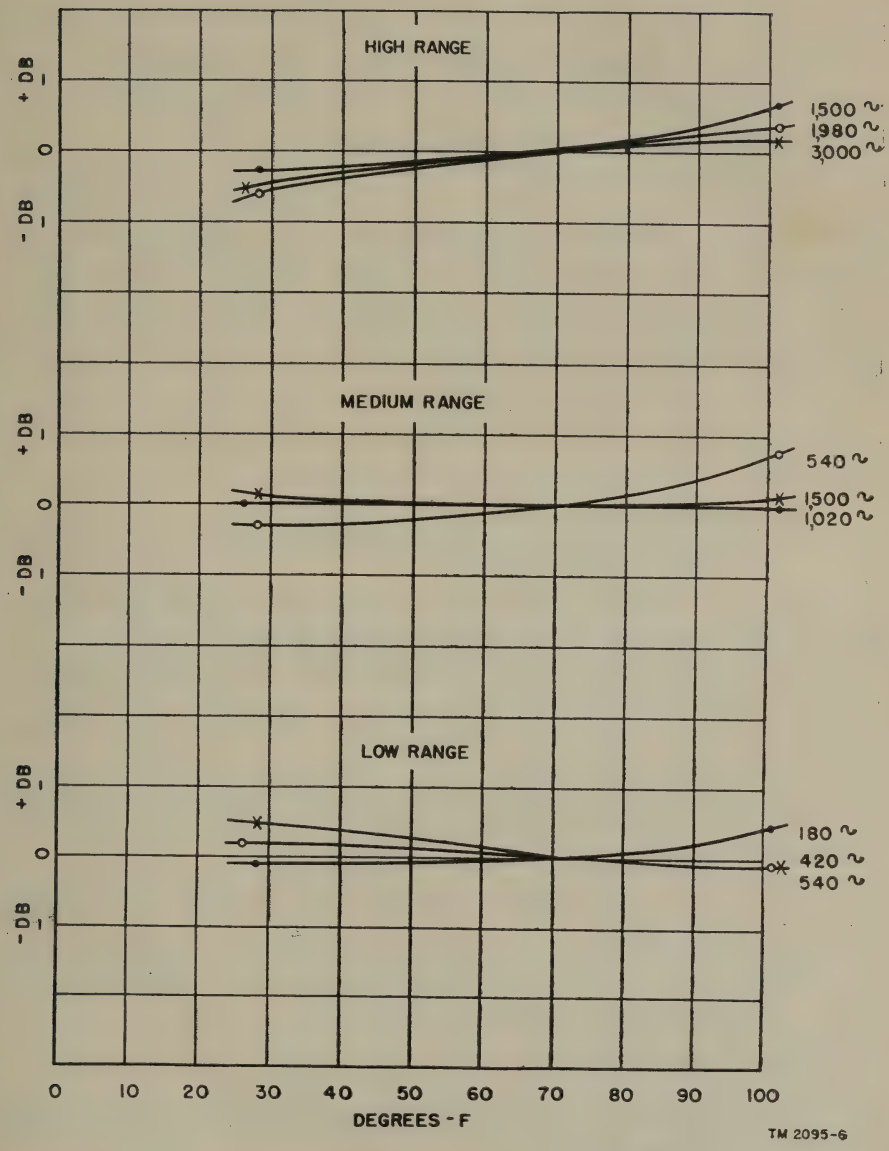



*Figure 6. Errors caused by temperature variation with Transmission Measuring Set TS-568/FT calibrated at 1,020 cycles only.*

# CHAPTER 2

# OPERATING INSTRUCTIONS

## Section I. SERVICE UPON RECEIPT OF EQUIPMENT

### 9. Service Upon Receipt of New Equipment

*a.* UNCRATING, UNPACKING, AND CHECKING. Transmission Measuring Set TS–568/FT is shipped in oversea packing cases or domestic packing cases. When uncrating and unpacking, be careful not to injure the equipment by thrusting tools into the interior. Do not damage the packaging material more than is necessary. Store the inside packaging in the shipping container for future use.

*b.* STEP-BY-STEP INSTRUCTIONS FOR UNCRATING AND UNPACKING EXPORT SHIPMENTS.

(1) Cut and fold back the metal straps.
(2) Remove the nails with a nail puller and lift off the top of the shipping container.
(3) Cut the tape and seals of the case liner so that the waterproof paper is damaged as little as possible.
(4) Lift out the fiberboard pads used for blocking and bracing the equipment.
(5) Lift out the packaged test set. Carefully remove the waterproof wrap.
(6) Cut the tape sealing the top flaps of the carton so that the carton is not damaged. Open the carton and remove the moisture-vaporproofed package.
(7) Cut off the moisture-vaporproofed barrier. Remove the inner carton.
(8) Open the inner box and remove the top cushioning cells and/or pads. Remove the desiccant and packaged technical manuals. Lift out the set.
(9) Store the interior packaging material (except the desiccant) in the inner carton for future use.
(10) Inspect the equipment thoroughly for possible damage during shipment.
(11) Check the contents of the packing case against the master packing slip.

*c.* UNPACKING DOMESTIC PACKING CASES. The instructions given in *b* above apply to unpacking domestic shipments except for cutting the metal bands. Domestic packing cases are not bound with metal straps.

## 10. Preparation for Use

*a.* Check the front panel for chips, cracks, and damaged parts.

*b.* Check controls and binding post nuts for ease of movement and positive action.

*c.* With a clean dry cloth, remove all dust, dirt, and grease accumulations.

*d.* Information concerning grounding arrangements, calibration of the test set, test precautions, and operating procedures is contained in paragraphs 13 through 21. Read these instructions carefully before using set.

*e.* Upon receipt of used or reconditioned equipment, follow the instructions in paragraph 9 and in this paragraph to uncrate, unpack, and to check the equipment and prepare it for use.

*f.* Check the used or reconditioned equipment for tags or other indications which pertain to changes in the wiring of the equipment. If any changes in the wiring have been made, note the change in this manual, preferably on the schematic diagram.

# Section II. CONTROLS AND INSTRUMENTS

## 11. Controls

The following table lists the controls on the front panel of TS–568/FT and gives their location and function (fig. 1).

| Control | Location | Function |
|---|---|---|
| CAL control (R–8) | Beneath metal plate at top left side of panel. | A screwdriver-operated potentiometer used in adjusting the feedback calibrating circuit during primary calibration. |
| Circuit switch (S–2). | Top left side of panel, right side of CAL control. | A five-position switch which varies the internal connections for different calibrating and measuring operations. The five positions are CAL and MEAS under the heading NOISE, and CAL, 600w, and $N_G$ under the general heading ANAL. |
| LMH switch (S–1). | Top right side of panel. | A three-position switch used to vary the frequency range of the tuned circuits in the equipment by changing the value of the inductance across tuning capacitors. |

| Control | Location | Function |
|---|---|---|
| GAIN control (R–9). | Top right side of panel. | Screwdriver-adjusted potentiometer used to compensate for temperature effects. |
| Capacitor C–1 | Lower right side of panel. | Variable capacitor which determines the resonant frequency of the tuned circuit. |
| Capacitor C–2 | Lower center of panel. | Capacitor which is adjusted in steps of .001μf to vary the frequency range of the tuned circuits in the equipment. |
| Capacitor C–3 | Lower left side of panel. | Capacitor which is adjusted in steps of .01 μf to vary the frequency range of the tuned circuits in the equipment. |

*Note.* Switch S–2 is referred to as the circuit switch in the text that follows.

### 12. Panel Connections

The IN binding posts for connection to the telephone circuit under test or to the TO SET binding posts of the TIF (telephone influence factor) couplers are at the left. The OUT binding posts of TS–559/FT are on the right and are connected to the IN binding posts of TS–559/FT. The GND binding post on the lower right side of the panel is connected to the GND binding post of TS–559/FT and is grounded. The C binding post on the upper right side is connected to the C binding post on TS–559/FT, which in some cases must be specially provided and wired as described in paragraph 13.

## Section III. OPERATION

### 13. Equipment Connections

*a.* Transmission Measuring Set TS–568/FT has been designed for use with Transmission Measuring Sets TS–559/FT that have been modified by the addition of a C binding post. An unmodified TS–559/FT should be modified by the addition of an Eby type 46, or equal, insulated binding post on the panel. Drill a $^{9}/_{32}$-inch diameter hole in the panel $^{1}/_{2}$ inch from the left side and $1^{3}/_{4}$ inches from the top edge. This hole should be elongated to $^{5}/_{16}$ inch to fit the insulated shank of the binding post. The binding post should

be assembled to the panel with the following parts placed in order on the under side of the panel: a paper base insulating washer, a soldering terminal, a lockwasher, and a nut. This binding post should be connected by means of a shielded lead to the make contact terminal of J–16, where a shielded lead from the XI varistor (WECo 18A) is already connected. Terminal 1 of the T–4 (WECo 169–A) output transformer is connected to the XI varistor. The shield of the new lead should be connected to the panel ground.

*b.* Stamp or mark the letter C on the panel directly below the new binding post (fig. 7). Add the new connection to the circuit diagram in the set cover.

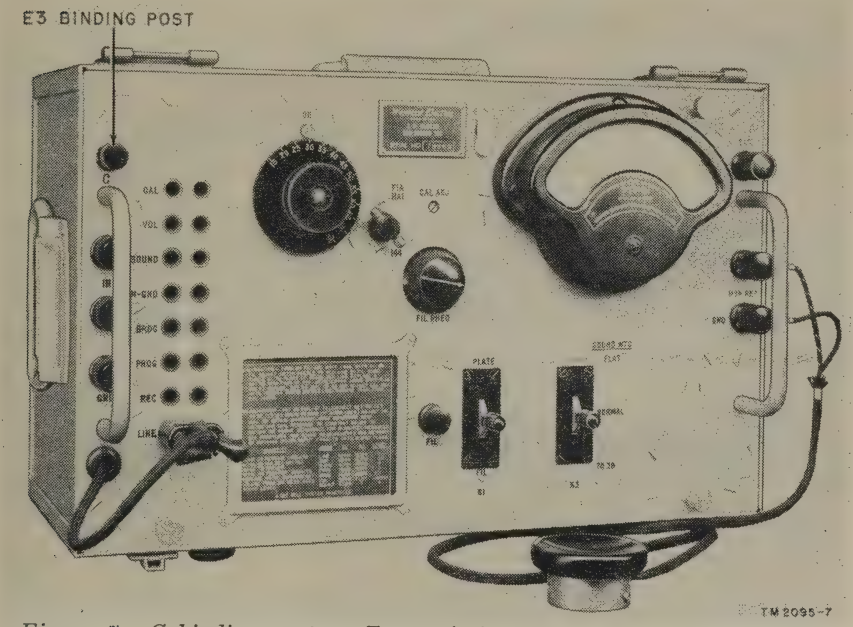



*Figure 7. C binding post on Transmission Measuring Set TS–559/FT.*

## 14. Calibration

The calibration and operation of the TS–568/FT and TS–559/FT combination are described below. There are two types of calibration—primary and field.

*a.* Primary calibration is the adjustment of the TS–568/FT feedback calibrating circuit for future routine calibrations and determines the tuning capacitor settings and over-all sensitivity at the various frequencies for the particular TS–568/FT and TS–559/FT combination. It establishes reference values of db (decibels) for the various measurements and provides a check on the internal calibration of TS–559/FT. A calibration chart is prepared from the data obtained in this primary calibration.

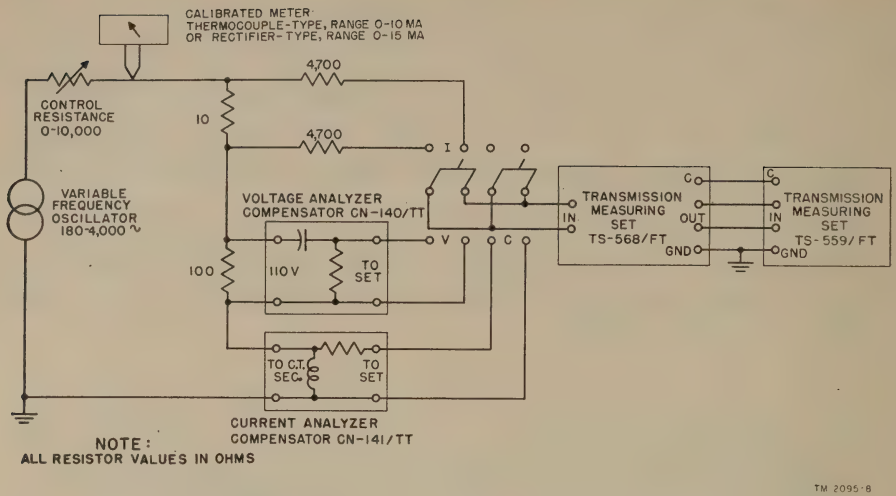



*Figure 8. Connections of apparatus for primary calibration.*

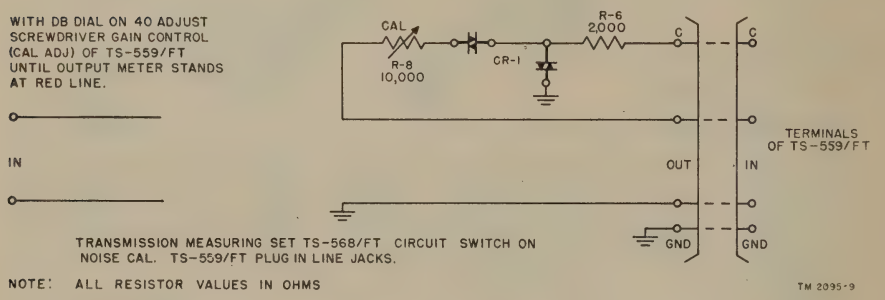

WITH DB DIAL ON 40 ADJUST SCREWDRIVER GAIN CONTROL (CAL ADJ) OF TS-559/FT UNTIL OUTPUT METER STANDS AT RED LINE.
CAL
R-8 10,000
CR-1
R-6 2000
TERMINALS OF TS-559/FT
IN
OUT
IN
GND
GND
TRANSMISSION MEASURING SET TS-568/FT CIRCUIT SWITCH ON NOISE CAL. TS-559/FT PLUG IN LINE JACKS.
NOTE: ALL RESISTOR VALUES IN OHMS
TM 2095-9

*Figure 9. Calibration for noise measurement.*

*b.* Field calibration is an essential part of each harmonic analysis. It is performed to check and maintain the gain of the TS–568/FT and TS–559/FT combination at the proper value. It is made only with TS–568/FT tuned to a frequency of 1,020 cycles.

## 15. Primary Calibration

A primary calibration should be made for each particular combination of the transmission measuring sets to be used in the field and should be performed at least once every 6 months. The calibration should be checked at least once every 2 months at 2 frequencies in each frequency band to prevent the taking of erroneous data.

*a.* Required Apparatus and Connections. Figure 8 indicates the connections and apparatus necessary for a primary calibration of the TS–568/FT and TS–559/FT combination. The calibrating

circuit includes a variable frequency oscillator (180 to 4,000 cycles), a thermocouple or alternating-current meter for measuring 10 milliamperes, a control resistance, four resistances to provide the proper currents or voltages, and a switching arrangement to select one of the following circuits:

(1) A 600-ohm circuit (calibrating current 10 microamperes in the TS–568/FT 600-ohm input circuit).

(2) Voltage analyzer compensator (calibrating voltage 1 volt between the 110-volt terminals of the compensator).

(3) Current analyzer compensator (calibrating current 10 milliamperes in the input of the compensator).

*Note.* Each of these circuits may be calibrated directly. The calibration for the noise-to-ground circuit may be derived from the 600-ohm circuit calibration.

*b.* TRANSMISSION MEASURING SET TS–559/FT CALIBRATION. With the apparatus connected as shown in figure 8, proceed as follows:

(1) Turn on filament supply of TS–559/FT by pulling out FIL key. Adjust A battery and check B battery as usual.

(2) While tube filaments are heating, set TS–559/FT DB dial on 45. Put plug in LINE jacks. Operate key K–3 to NORMAL position and key K–4 to 144 position.

(3) Throw TS–568/FT circuit switch (S–2) to NOISE MEAS. This connects input terminals of TS–568/FT directly to TS–559/FT input for 1,000-cycle primary calibration of TS–559/FT (fig. 10).

(4) Adjust oscillator for 1,000 cycles. Adjust control resistance until calibrating meter reads 10 milliamperes.

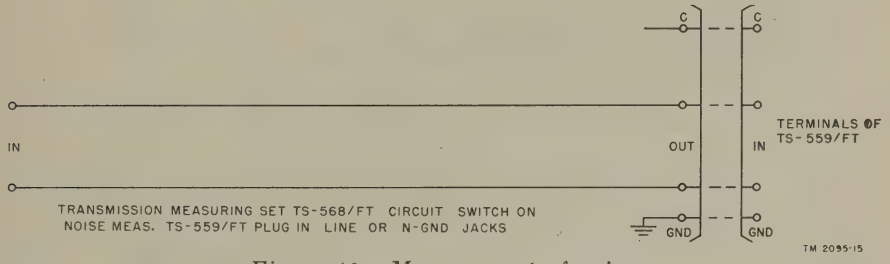



*Figure 10. Measurement of noise.*

(5) Throw switch in calibrating circuits to I. (The C switch should be open.) The calibrating circuit is now adjusted so that 10 microamperes of 1,000-cycle current flow in the 600-ohm circuit of TS–559/FT.

(6) By means of the screw driver CAL ADJ control on panel of TS–559/FT, adjust the output meter to +2.8 db (dial to 45 db). (Ten microamperes of 1,000-cycle current in 600 ohms is 47.8 db above reference noise.)

*Note.* This completes a calibration of TS–559/FT using a 1,000-cycle oscillator. Calibration by the usual method should check within about .2 db if the internal calibrating arrangement is functioning properly. If the two calibrations do not check, the internal feedback calibrating circuit of TS–559/FT may be adjusted by following the primary calibrating instructions for that set.

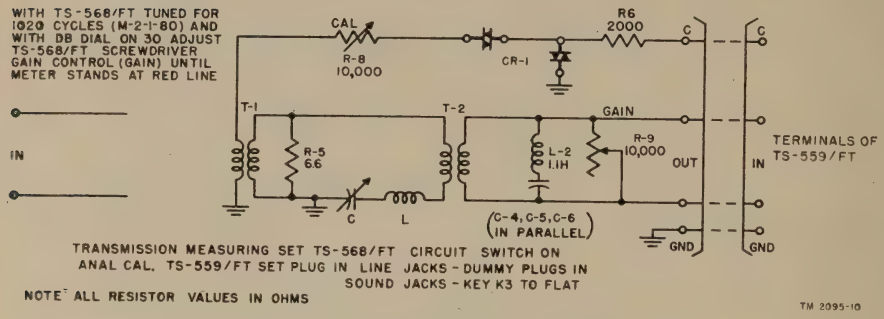



*Figure 11. Calibration for analyses.*

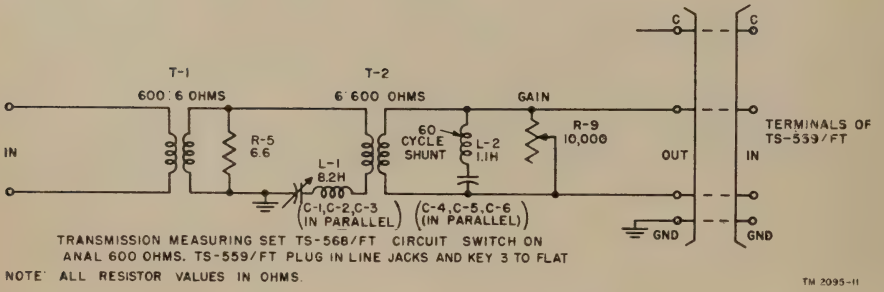



*Figure 12. Analyses of noise-metallic.*

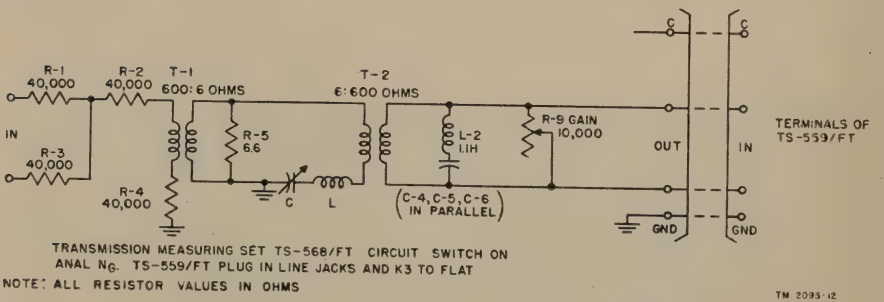



*Figure 13. Analyses of noise-to-ground.*

(7) Throw TS–568/FT circuit switch (S–2) to NOISE CAL (fig. 9). This disconnects the 1,000-cycle power and closes the feedback circuit of TS–568/FT for a primary calibration of TS–559/FT. If no indication is obtained on the output meter, reverse the plug in LINE jacks.

(8) Set DB dial of TS–559/FT to 40 db.

(9) Remove small cover plate and adjust screw driver calibrating adjustment (CAL) of TS–568/FT (R–8, fig. 9) until the output meter of TS–559/FT reaches the red mark. Do not change screw driver adjustment of TS–559/FT.

(10) Return TS–559/FT dial to 45 db, throw TS–568/FT circuit switch (S–2) to NOISE MEAS, and check whether output meter returns to +2.8 db. This is a recheck of the primary 1,000-cycle calibration of TS–559/FT.

(11) The calibrating circuit of TS–568/FT is now adjusted to calibrate TS–559/FT. No further change should be made in the screw driver calibrating adjustment (CAL) of TS–568/FT until the next primary calibration. Replace cover plate.

*c.* TRANSMISSION MEASURING SET TS–568/FT 1,020-CYCLE CALIBRATION.

(1) With R–8 of TS–568/FT and control CAL ADJ of TS–559/FT adjusted as described above, throw circuit switch (S–2) to ANAL CAL (fig. 1). Set LMH switch on M and adjust tuning capacitors for 1,020 cycles as follows: .01 $\mu$f (microfarad) on 2, .001 $\mu$f on 1, C–1 on 80.

(2) Place the plug of TS–559/FT in LINE jacks, dummy plugs in SOUND jacks, throw key K–3 to FLAT and key K–4 to 144. This is the standard arrangement of TS–559/FT for use with TS–568/FT.

(3) Set TS–559/FT DB dial to 30. If meter does not indicate, reverse plug in jacks. Adjust screw driver GAIN control (R–9) of TS–568/FT until meter of TS–559/FT reaches red line. Gain of TS–568/FT and TS–559/FT combination now is adjusted properly and should not be changed during the subsequent single-frequency calibrations, unless a check calibration at 1,020 cycles indicates that readjustments are necessary.

*d.* TRANSMISSION MEASURING SET TS–568/FT SINGLE-FREQUENCY CALIBRATIONS. The single-frequency calibration determines the tuning capacitor settings and calibration constants to complete a calibration chart. A typical chart for TS–568/FT calibrated with TS–559/FT is included in appendix I. This chart should be used as a guide to the capacitor settings and constants

in carrying out the calibration which follows. At each frequency for which a calibration is desired, proceed as follows:

(1) Adjust oscillator as accurately as possible to desired frequency. Adjust control resistance until 10 milliamperes flow in calibrating circuit. Throw calibrating circuit switch to I. (The C switch should be open.)

(2) Set TS–568/FT circuit switch (S–2) on ANAL 600 ohm (fig. 1). Place TS–559/FT plug in LINE jacks, dummy plugs in SOUND; throw key K–3 to FLAT and key K–4 to 144.

(3) Set tuning capacitors at approximate settings for particular frequency. Tune capacitors for maximum deflection of output meter of TS–559/FT (Do not change gain adjustment of either set during this adjustment). Record capacitor settings on calibration chart (similar to chart in appendix I).

(4) Record sum of readings of DB dial and output meter of TS–559/FT on calibration chart in column *Db for 1 volt to ground* opposite proper frequency. The settings for *Db for 1 mca in 600 ohms* are determined by subtracting 20 db from the values just recorded.

(5) Throw calibrating circuit switch to V and record sum of TS–559/FT DB dial and output meter readings on chart under *Db for 1 volt across voltage compensator.*

(6) Open the I–V switch in the calibrating circuit and close the C switch. Record sum of TS–559/FT DB dial and output meter readings on chart under *Db for 10 mils in current compensator.*

(7) Upon completion of these steps for each frequency of interest, the primary calibration is completed.

*Note.* Check the A battery voltage of TS–559/FT and the gain control settings of both sets several times during the primary calibrations. The gains which use the proper settings of TS–568/FT circuit switch (S–2) (figs. 9 and 11) can be checked readily. The internal feedback circuit of TS–559/FT should not be used for calibrating itself while both sets are connected together, because errors in calibration may result for certain positions of the TS–568/FT circuit switch (S–2).

## 16. Field Calibration

To calibrate both sets in the field, proceed as follows:

*a.* Connect TS–568/FT as shown in figure 14. Be sure the ground binding posts are connected to ground.

*b.* Turn on filament supply of TS–559/FT by pulling out FIL key, adjust A battery, and check B battery.

*c.* During warm-up period, set TS–568/FT circuit switch (S–2) on NOISE CAL (fig. 9) and the DB dial of TS–559/FT on 40. The input plug of TS–559/FT should be in the LINE jacks, key K–3 to NORMAL, and key K–4 to 144. If there is no indication on the output meter, reverse plug in jacks.

*d.* Use the screw driver adjustment (CAL ADJ) on panel of TS–559/FT to bring the output meter to red line; TS–559/FT is then calibrated.

*e.* Set TS–568/FT circuit switch (S–2) on ANAL CAL (fig. 11), LMH switch on M, and tuning capacitors on 2–1–80. Set TS–559/FT DB dial on 30. Place TS–559/FT plug in LINE jacks, dummy plugs in SOUND jacks, key K–3 to FLAT, and key K–4 to 144. If there is no indication on output meter, reverse plug in jack.

*f.* Use the screw driver GAIN adjustment on panel of TS–568/FT to bring the output meter of TS–559/FT to the red line. TS–568/FT is now calibrated.

## 17. Operation

Specific instructions for making the tests and measurements most frequently performed with Transmission Measuring Set TS–568/FT follow. When making measurements where a high degree of accuracy is desired, corrections to be made to lessen the errors due to nonlinearity can be derived from figure 5.

*a.* The feedback calibrating circuit is temperature-compensated at 1,000 cycles and can be depended on to adjust the gain at this frequency within .1 db of the correct value of any temperature between 30° F. and 100° F. At frequencies other than 1,000 cycles, the errors to be expected from temperature variations are shown by the curves illustrated in figure 6. As indicated, these errors do not exceed .5 db in most cases. Where greater accuracy is desired, these curves may be used to correct the measured values.

*b.* Figure 14 shows, schematically, and figure 3, photographically, the connections of TS–568/FT, TS–559/FT, and analyzer compensators for measurements on power and telephone circuits. No attempt is made to indicate the details of connections to the many different types of power and telephone circuits encountered in practice. The precautions to be observed in connecting the current and voltage analyzer compensators to power circuits are mentioned (in the descriptions of these compensators) in chapter 5.

*c.* The GND binding posts of TS–568/FT and TS–559/FT always should be connected together and grounded for all types of measurement.

*d.* When the instruments are used for measurements of Kv.T and I.T products and harmonic analyses in power-generating

plants or large substations, the effects of external fields may interfere markedly with the taking of data. Pick-up from either electric or magnetic fields is indicated when a reading of the output meter of TS–559/FT is obtained with TS–568/FT disconnected from the line. Magnetic pick-up may be decreased materially by moving the instruments out of the field or, in some cases, by suitably orienting both transmission-measuring sets with respect to the stray fields. The results of laboratory tests indicate that most of the pick-up from electric fields occurs in the noise measuring set plug and cord. In the presence of strong electric fields, reductions of as much as 25 db can be secured by using a shielded cord and plug between the OUT terminals of TS–568/FT and the LINE jacks of TS–559/FT.

*e.* The various types of measurement that can be made with TS–568/FT and TS–559/FT, together with the position of the circuit switch (S–2) of TS–568/FT and the input plug and switches of TS–559/FT, are shown in tabular form in appendix I. Transmission Measuring Set TS–568/FT is not arranged for analyses of voltage across the receiver at a substation.

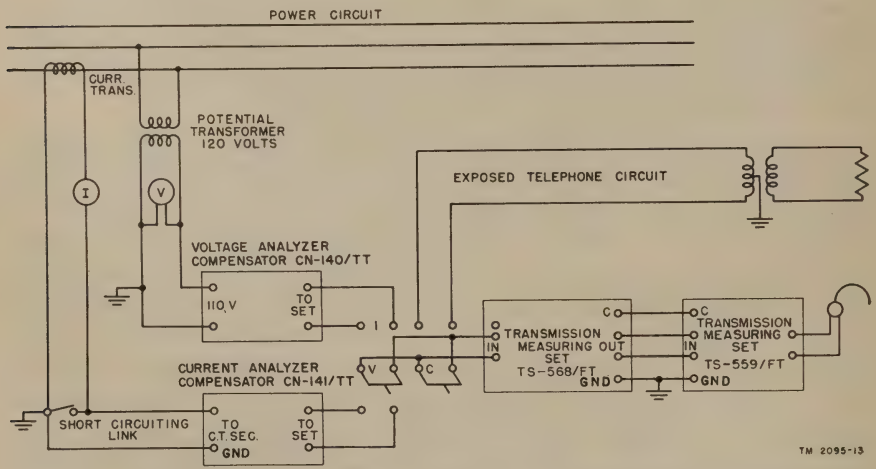


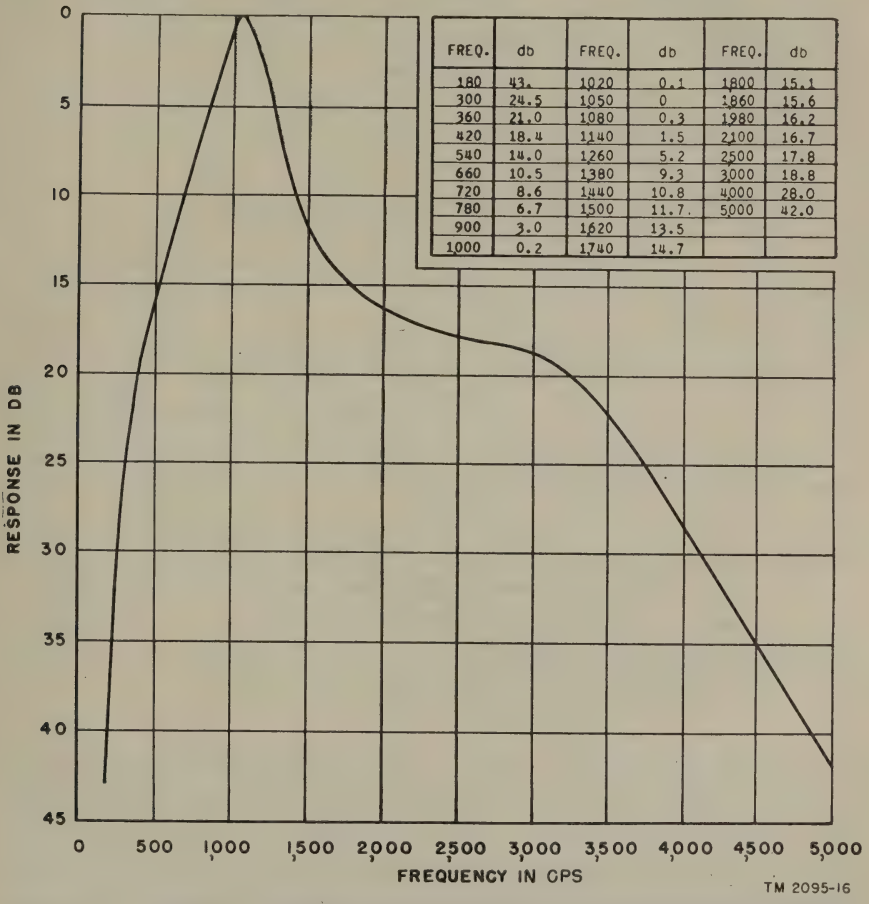

*Figure 14. Connections of Transmission Measuring Set TS–568/FT, Transmission Measuring Set TS–559/FT, and analyzer compensators for tests on power and telephone circuits, schematic diagram.*

## 18. Measurement of Noise, Kv·T, or I·T

To measure noise Kv·T or I·T products, place TS–568/FT circuit switch (S–2) in NOISE MEAS position, and connect the input terminals directly to the input terminals of TS–559/FT (fig. 10). With the TS–559/FT plug in the LINE jacks (key K–3 of TS–559/FT to NORMAL), measurements of noise, Kv·T, or I·T are

made as described in information on the TS–559/FT or the analyzer compensators.

*Note.* To prevent shorting of the power measuring circuits to ground, be sure to open the switches which connect the current and voltage analyzer compensators to the TS–568/FT input before inserting or removing the input plug of TS–559/FT. The low-frequency limit of TS–568/FT is 180 cycles. As a result, it is not possible to make measurements of power circuit fundamental frequencies. To determine the rms (root mean square) magnitude of the fundamental voltage and current, use a conventional voltmeter and ammeter.




| FREQ. | db | FREQ. | db | FREQ. | db |
|---|---|---|---|---|---|
| 180 | 43. | 1020 | 0.1 | 1800 | 15.1 |
| 300 | 24.5 | 1050 | 0 | 1860 | 15.6 |
| 360 | 21.0 | 1080 | 0.3 | 1980 | 16.2 |
| 420 | 18.4 | 1140 | 1.5 | 2100 | 16.7 |
| 540 | 14.0 | 1260 | 5.2 | 2500 | 17.8 |
| 660 | 10.5 | 1380 | 9.3 | 3000 | 18.8 |
| 720 | 8.6 | 1440 | 10.8 | 4000 | 28.0 |
| 780 | 6.7 | 1500 | 11.7 | 5000 | 42.0 |
| 900 | 3.0 | 1620 | 13.5 | | |
| 1000 | 0.2 | 1740 | 14.7 | | |

*Figure 15. Relative interfering effects of telephone line currents or voltages in terms of decibels—144 line weighting.*

## 19. Harmonic Analyses

*a.* INTRODUCTION. An accurate harmonic analysis of noise on a telephone circuit will often indicate the probable source of the interference. For example, when a power line exposure causes the

| FREQ. | DB | FREQ. | DB | FREQ. | DB |
|---|---|---|---|---|---|
| 180 | 30.0 | 1,000 | 5.0 | 1,620 | 7.7 |
| 300 | 16.5 | 1,020 | 5.05 | 1,740 | 8.2 |
| 360 | 13.6 | 1,050 | 5.2 | 1,800 | 8.4 |
| 420 | 11.5 | 1,080 | 5.4 | 1,860 | 8.6 |
| 540 | 8.8 | 1,140 | 5.7 | 2,000 | 9.0 |
| 660 | 7.1 | 1,260 | 6.3 | 2,500 | 10.2 |
| 720 | 6.5 | 1,380 | 6.8 | 3,000 | 11.6 |
| 780 | 6.0 | 1,440 | 7.0 | 4,000 | 21.0 |
| 900 | 5.4 | 1,500 | 7.3 | 5,000 | 42.0 |

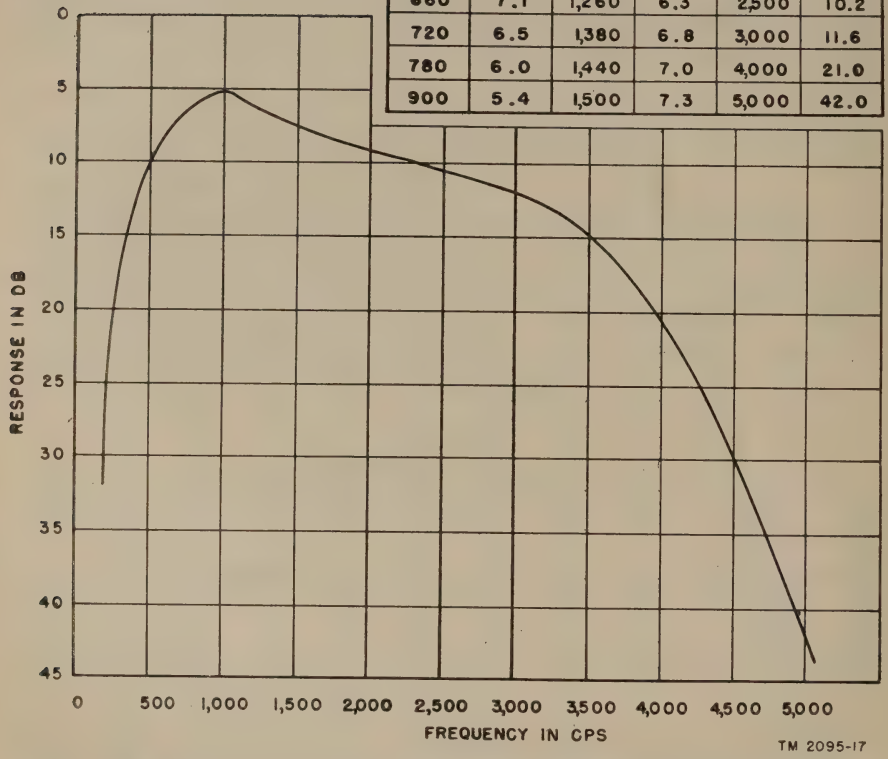



*Figure 16. Relative interfering effects of telephone line currents or voltages in terms of decibels—F1A line weighting.*

noise, harmonics in the region from about 1,100 to 2,500 cycles indicate a motor-generator set for a direct-current transit power line as a strong probable cause; if harmonics from 360 to 720 cycles are also present, a rotary converter for a direct-current transit power line is indicated as a probable cause. If one harmonic only is present, a power line, which has a power factor correction capacitor resonating with the line inductance at the particular interfering frequency, is the probable source of the noise.

*b.* PROCEDURE. Harmonic analyses of a voltage or current are made as follows:

(1) With the TS–568/FT and TS–559/FT combination calibrated, set circuit switch on ANAL 600 ohms (fig. 12)

(or ANAL NG for analysis of noise-to-ground (fig. 13)). Place TS–559/FT plug in LINE jacks, dummy plugs in SOUND jacks, key K–3 to FLAT, and key K–4 to 144.

(2) By means of the LMH switch and the capacitor dials, progressively tune through the frequency range starting with 180 cycles. Keep setting of DB dial of TS–559/FT low enough to hear tone in monitoring receiver. When single-frequency tone is heard, adjust the tuning capacitors for maximum reading on the output meter. Identify frequency from calibration chart and record sum of DB dial and output meter reading on the data sheet. Repeat for other frequencies. Only measurements for which definite peaks can be observed on the output meter should be recorded. If peaks are observed at capacitor settings not given in the calibration chart, record settings as well as dial meter readings and determine frequency later.

*Note.* The calibrating arrangements are such that TS–559/FT is always calibrated so that the over-all value of noise Kv·T or I·T may be checked readily during the progress of an analysis by arranging TS–568/FT and TS–559/FT for noise measurement. Be sure to restore key K–3 of TS–559/FT to NORMAL and operate key K–4 to proper position. Such a check on the over-all values is particularly desirable when analyzing variable quantities.

*c.* CALCULATION OF RESULTS.

(1) The db readings obtained in harmonic analyses may be converted into currents and voltages by the following procedure:

Let $R_f$ = db reading (at frequency f) on power or telephone circuit.

$C_f$ = db primary calibration (at frequency f).

Then $R_f - C_f$ = db referred to primary calibration currents or voltage (at frequency f).

| Telephone circuit | | Power circuit | |
|---|---|---|---|
| $I_M$ | $V_C$ | $I_P$ | $V_P$ |
| 1 mca | 1 volt | 10 mils | 1 volt |

Appendix I contains a conversion table from which numerical ratios which correspond to the db obtained from $R_f - C_f$ may be determined.

(2) The sample data sheet in appendix I illustrates calculations of the contributions at individual frequencies to noise-metallic, noise-to-ground, and voltage TIF on I·T product from assumed analyses. The noise and TIF weighting factors given in this case are 144 line weighting and 1935 TIF weighting, respectively, for use when

telephone sets of the type using 337 transmitters and 144 receivers are of interest. Where telephone sets which use F1A transmitters and HA1 receivers are of interest, F1A line weighting and tentative 1941 TIF weighting should be used. This example should be considered illustrative only.

(3) Individual frequency contributions to telephone circuit noise-metallic or noise-to-ground may be expressed in dba (decibels adjusted), and the calculations may be made without conversion into currents (for noise-metallic), voltages (for noise-to-ground), or noise units.

Let $R_f$ = db reading (at frequency f) of noise-metallic or noise-to-ground.

$C_f$ = db primary calibration (at frequency f), db for 1 mca in 600 ohms.

$W_f$ = db line weighting (at frequency f—from figure 15 for 144 line weighting or from figure 16 for F1A line weighting).

$F_f$ = db correction factor (at frequency f) to be added to reading $R_f$ to obtain noise contribution (in dba) at frequency f.

Then $F_f = 27.8 - W_f - C_f$ for either noise-metallic or noise-to-ground. This need be determined only once for each primary calibration and $R_f + F_f$ = dba noise contribution (at frequency f).

The term dba (decibels adjusted) indicates that the noise has been adjusted, so that equal values of noise in dba are equal in interfering effect, regardless of the types of telephone sets involved.

(4) For some types of analyses, it may be desirable to have the single-frequency components of noise-metallic expressed in db above reference noise unweighted. In such a case the factor $W_f$ in equations above would be zero for all frequencies.

(5) A convenient method of combining the individual frequency noise component (expressed in db) for comparison with the measured total is to add the power ratios which correspond to the individual db components and then to convert the sum of the power ratios back into db. These conversions between power ratios and db may be made by use of the table contained in appendix I. Sample calculations illustrating the various steps in the above procedure are shown in appendix I also.

(6) Use of the weighting curve shown in figures 15 and 16 ordinarily will involve some degree of approximation because of deviations of the characteristics of individual TS–559/FT sets from the design objective. Consequently, if weighting curves are available for the particular TS–559/FT set in use, they should be used rather than the curves shown in figures 15 and 16 in calculations on a db basis by the method outlined above.

## 20. Equipment Performance Checklist

*a.* GENERAL. The equipment performance checklist will help to determine whether or not Transmission Measuring Set TS–568/FT is functioning properly. This checklist gives the item to be checked, the action or condition under which the item is checked, the normal indications of correct operation (what should happen), and the corrective measures (what to do) the operator may take.

*b.* ACTION OR CONDITION. The information given in *Action or condition* column represents an action that must be taken to check the normal indication given in the *Normal indication* column.

*c.* NORMAL INDICATION. The normal indications listed include the visible signs that the operator will find when he checks the items. Apply the recommended corrective measures if the indications are not normal.

*d.* CORRECTIVE MEASURE. When normal indications are not present, the operator may perform the corrective measures listed without turning in Transmission Measuring Set TS–568/FT for repairs. If the set is completely inoperative or if the recommended corrective measures do not yield results, turn the equipment over to the maintenance unit as soon as possible.

*e.* CHECKLIST.

| Item No. | Item | Action or condition | Normal indication | Corrective measure |
|---|---|---|---|---|
| 1 | Varistor CR–1 | Calibration for noise measurement | Output meter on TS–559/FT gives proper reading after primary calibration. | Varistor may be defective; replace. |
| 2 | CAL control (R–8). | Calibration for noise measurement | | Check potentiometer for continuity; replace if defective. |
| 3 | Circuit switch, (S–2). | Calibration for noise measurement | | Open switch; repair or replace. |
| 4 | GAIN control (R–9). | Calibration for analyses | Output meter is set to red line when GAIN control is operated. | Replace GAIN control. |
| 5 | Transformers T–1 or T–2. | Calibration for analyses | | Check transformers for continuity; replace if defective. |

## 21. Operation Under Unusual Conditions

*a.* Operation of Transmission Measuring Set TS–568/FT in tropical, arctic, or desert regions, where extremes of temperature and humidity often occur, involves problems which require special care of the equipment. In most cases, this special care must be determined by the particular installation and resultant degree of exposure to these severe conditions. For information covering the special treatment of equipment subject to these conditions, see paragraph 23.

*b.* After the equipment has been treated in accordance with the procedures described in paragraph 23, operate the equipment in the same manner as under normal conditions.

# CHAPTER 3

# MAINTENANCE INSTRUCTIONS

## Section I. PRESERVATIVES

### 22. Lubrication

Lubrication is not required for Transmission Measuring Set TS–568/FT.

### 23. Weatherproofing

*a.* GENERAL. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

*b.* TROPICAL MAINTENANCE. A special moistureproofing and fungiproofing treatment has been applied to the equipment and provides a reasonable degree of protection. This treatment is fully explained in TB SIG 13 and TB SIG 72.

*c.* WINTER MAINTENANCE. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are fully explained in TB SIG 66.

*d.* DESERT MAINTENANCE. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are fully explained in TB SIG 75.

## Section II. PREVENTIVE MAINTENANCE SERVICES

### 24. Definition and Importance of Preventive Maintenance

*a.* DEFINITION. Preventive maintenance is work performed on equipment (usually when it is not in use) to keep it in such good working order that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to eliminate defects and breakdowns which require trouble shooting and repair.

*b.* IMPORTANCE. Since the failure or inefficient operation of even one item of equipment may cause the breakdown of an entire communication system, the importance of preventive maintenance cannot be overemphasized. Operators must maintain equipment placed in their charge in such condition that it will work at top efficiency at all times.

## 25. Preventive Maintenance Techniques

Most of the electrical parts of Transmission Measuring Set TS–568/FT require routine preventive maintenance of one kind or another. Because maintenance techniques cannot be applied indiscriminately, definite and specific instructions are required. This section of the manual contains these specific instructions and serves as a guide for personnel assigned to perform maintenance operation.

## 26. Preventive Maintenance Tools and Materials

The tools and materials listed below are used in performing preventive maintenance on Transmission Measuring Set TS–568/FT and must be on hand before action is taken.

| Signal Corps stock No. | Name and description |
|---|---|
| 6Z1415 | Brush, cleaning, long bristle. |
| | Common hand tools. |
| 6G184.1 | Carbon tetrachloride: in 8-oz. metal can. |
| 6Z2056 | Cloth, lint-free; 6" x 9"; twill-jean. |
| 6Z7500–0000 | Paper, sand; #0000, 9" x 11" sheets. |
| 6G1516 | Polish, metal, paste. |
| | Solvent, dry-cleaning (SD); Federal P–S–66a1 (Amend. 1). |

*Note.* Gasoline will not be used as a cleaning fluid for any purpose.

## 27. Preventive Maintenance Checklist

The following checklist is a summary of preventive maintenance services that should be performed on TS–568/FT. The list indicates what to check, when to check, how to check, and what precautions to take before, during, and after checking the equipment.

| Item No. | What to check | When to check* | How to check | Precautions |
|---|---|---|---|---|
| 1 | Transmission measuring set exterior and panel. | D | Inspect for damage, chipped paint, dirt, dust, corrosion, loose or missing screws. Wipe with clean cloth slightly moistened with solvent (SD) to remove oil, grease, or foreign matter. Wipe with dry cloth. | Tighten screws snugly. Never force them. |

| Item No. | What to check | When to check* | How to check | Precautions |
|---|---|---|---|---|
| 2 | Jacks | W | Remove set from case by taking out the three mounting screws. Inspect the jacks for dirt, dust, and other foreign matter. Be sure jacks are tightly fastened. Clean with solvent (SD) and a clean dry cloth. | Do not tighten jack screws more than necessary. Never force them. |
| 3 | Controls | D | Inspect for freedom of action. See that only a normal amount of pressure is required to operate them. Be certain dials are not loose. | Do not overtighten screws holding dials. |
| 4 | Interior | M | Inspect wiring and other parts for excessive wear. Check contacts of keys and switches for dirt, dust or foreign matter. Look for corrosion and rust. See that all solder joints are secure. Check screws, nuts, and bolts. Tighten screw-type terminals. Remove dust or dirt from the interior with a long bristle cleaning brush. | Do not overtighten screws, nuts and bolts. If it is necessary to resolder, be sure no loose solder falls between other parts; this causes shorts. |
| 5 | Patching cords and plugs. | W | Inspect cords for dirt, dust, mildew, and fungus growth. Inspect plugs for corrosion and loose connections. Clean cords with clean dry cloth, wiping off dirt, dust, and foreign matter. If grease is on cords, use solvent (SD). | Never use soap and water when cleaning cords and plugs. Never use gasoline or other inflammable materials. Use a screw driver of proper size. |

| Item No. | What to check | When to check* | How to check | Precautions |
|---|---|---|---|---|
| | | | Tighten plug connections with screw driver. Clean plugs with Polish, metal, paste. | |
| 6 | Switch contacts. | M | After a prolonged period of inactivity, the switch contacts may become corroded. Clean with sandpaper. | Do not use emery cloth; the abrasive particles are conductive. |

* D—Daily; W—Weekly; M—Monthly.

# CHAPTER 4

# FIELD MAINTENANCE INSTRUCTIONS

## Section I. TROUBLE SHOOTING

### 28. Trouble Shooting Defined

Trouble shooting locates and corrects (within limitations) faults occurring in the equipment which cause breakdowns or interruptions in service. Detailed trouble-shooting information is contained in the paragraphs below.

### 29. Steps Involved in Trouble Shooting

*a.* TROUBLE-SHOOTING DATA. Before trouble shooting this equipment, the technician should have a thorough knowledge of the functioning of the equipment. Use the following trouble-shooting information supplied in this manual:

(1) Trouble location chart (*c* below).

(2) Measurement schematic diagrams (figs. 11, 12, and 13).

(3) Over-all schematic diagram of TS–568/FT (fig. 17).

(4) Theory of operation (par. 30).

*b.* TROUBLE-SHOOTING STEPS.

(1) Check the trouble report to determine the probable cause of trouble. When checking the report, refer to the over-all schematic diagram to localize the fault to a particular part.

(2) Inspect the equipment for damaged or broken wiring or defective parts. If the fault cannot be located by this method, trace the circuit by making continuity measurements.

(3) When locating the fault by elimination, start at a point where the circuit is known to have continuity and proceed step by step until the fault is located.

*c.* TROUBLE LOCATION CHART.

| Symptoms | Possible trouble | Corrections |
|---|---|---|
| 1. TS–559/FT cannot be calibrated according to procedure given in paragraph 15. | 1. Varistor or CAL control (R–8). | 1. Check and replace if defective. |

| Symptoms | Possible trouble | Corrections |
|---|---|---|
| 2. TS–559/FT cannot be calibrated according to procedure given in paragraph 15. | 2. Transformers T–1 or T–2, GAIN control (R–9), tuned circuit capacitors, or chokes. | 2. Check and replace if defective. |
| 3. TS–568/FT does not tune in harmonics. | 3. Switch contacts dirty__ | 3. Clean contacts with sandpaper. |

## Section II. THEORY OF OPERATION

### 30. Introduction

*a.* Noise, as pertaining to telephone circuits, is a component of acoustic sound heard in telephone receivers; such noise is caused by extraneous audio-frequency voltages and currents in the telephone circuit.

*b.* Circuit noise in the receiver of a telephone set arises from sources external to or from sources within the telephone plant; the latter will not be treated here. Noise from external sources is caused either by induction due to exposure to nearby systems, particularly power circuits, or by atmospheric static. When the noise is due to the inductive exposure of voice-frequency telephone circuits to power systems, the noise may consist of harmonics of the fundamental power system frequency of, slot harmonics due to induction motors connected to alternating-current systems, or of commutator ripple and other voltage variations due to rotating machines on direct-current systems. Noise from static is distributed over the frequencies of the voice channel, varies with time, and is not susceptible of analysis into single-frequency components.

*c.* By performing an accurate harmonic analysis of the noise currents or voltages on a telephone circuit, the probable source of interference can be determined. The offending source can be identified exactly by comparing its harmonic spectrum with that of the noise on the telephone circuit. If the harmonic spectrums of the noise currents or voltages on the telephone circuit and the suspected power line are identical, the suspected power line is the source.

*d.* Transmission Measuring Set TS–568/FT is designed as an adjunct to Transmission Measuring Set TS–559/FT to enable harmonic analyses of voltages and currents in telephone and power circuits to be performed. Also, circuits are provided for calibrating TS–559/FT for either noise measurements or harmonic analyses.

## 31. Calibration Theory

*a.* The calibration circuit of Transmission Measuring Set TS–568/FT consists of a feedback circuit similar to that used in TS–559/FT and is used to calibrate TS–559/FT as well as the TS–568/FT and TS–559/FT combination. The calibration of TS–559/FT is made with Transmission Measuring Set TS–568/FT circuit switch in the NOISE CAL position. A schematic of Transmission Measuring Set TS–568/FT circuit for this calibration is shown in figure 9. With the input plug of TS–559/FT in the LINE jacks, the TS–568/FT feedback circuit is connected between the output of TS–559/FT amplifier (connected through the C binding posts; the one on TS–559/FT may require installation as described in paragraph 13) and one side of TS–559/FT input transformer. The other side of this transformer is connected to ground.

*b.* When TS–568/FT and TS–559/FT are connected in this manner, varistor CR–1 and the CAL potentiometer R–8 are connected in a bridged T feedback between the output and input of the amplifier in TS–559/FT. Since the gain of TS–559/FT with LINE weighting is considerably greater at 1,000 cycles than at any other frequency, the feedback circuit, connected as described above, causes the amplifier to sing or howl at approximately the frequency of the peak response. The magnitude of the oscillation is controlled by R–8 so that the gain is set to the prescribed value (par. 15). The two sections of the varistor provide temperature compensation, maintaining the gain reasonably independent of temperature variations.

*c.* When TS–568/FT circuit switch is in the ANAL CAL position (fig. 1), the feedback circuit is connected between the output of the TS–559/FT amplifier and the input of TS–568/FT. The feedback path between the output and input of the amplifier consists of CAL potentiometer R–8 and varistor CR–1 as before, but now TS–568/FT is inserted in series with the feedback loop. TS–568/FT is tuned to 1,020 cycles. No adjustment is made of R–8. The gain of TS–568/FT is then adjusted by varying the amount of shunting resistance (R–9) across T–2 until the over-all gain of the TS–568/FT and TS–559/FT combination reaches the proper value.

## 32. Measurement Theory

*a.* Figure 12 shows the schematic circuit of TS–568/FT when arranged for analyses of noise-metallic. The input transformer (T–1) offers an impedance of about 600 ohms to the circuit under test and steps up the complex input current producing a voltage drop across the secondary resistance (6.6 ohms). This complex

voltage is then impressed upon a series-tuned circuit that includes the variable capacitance (C), the inductance (L), and the 6-ohm winding of the output transformer (T–2). The values of C and L are adjusted to provide a relatively low series impedance at the tuned frequency, while offering a high impedance at other frequencies. The current in this series circuit thus becomes practically single frequency in character.

*b.* The output transformer (T–2) steps up the single-frequency voltage impressed on its primary winding, the secondary voltage being applied to the 60-cycle shunt, the GAIN control (R–9), and the input circuit of TS–559/FT. The 60-cycle shunt is provided to suppress the fundamental frequency and to permit the measurement of small harmonics on a 60-cycle power system. The GAIN control (R–9) is provided to compensate for the effect of temperature on the effective resistance of the tuned circuit.

*c.* The input arrangement for analysis of noise-to-ground is shown in figure 13. In this case, the 600-ohm winding of the input transformer (T–1) is connected in series with an arrangement of resistances which provides an impedance of approximately 100,000 ohms between the telephone line wires and ground. The remaining part of the TS–568/FT circuit is the same as for noise-metallic analysis described above.

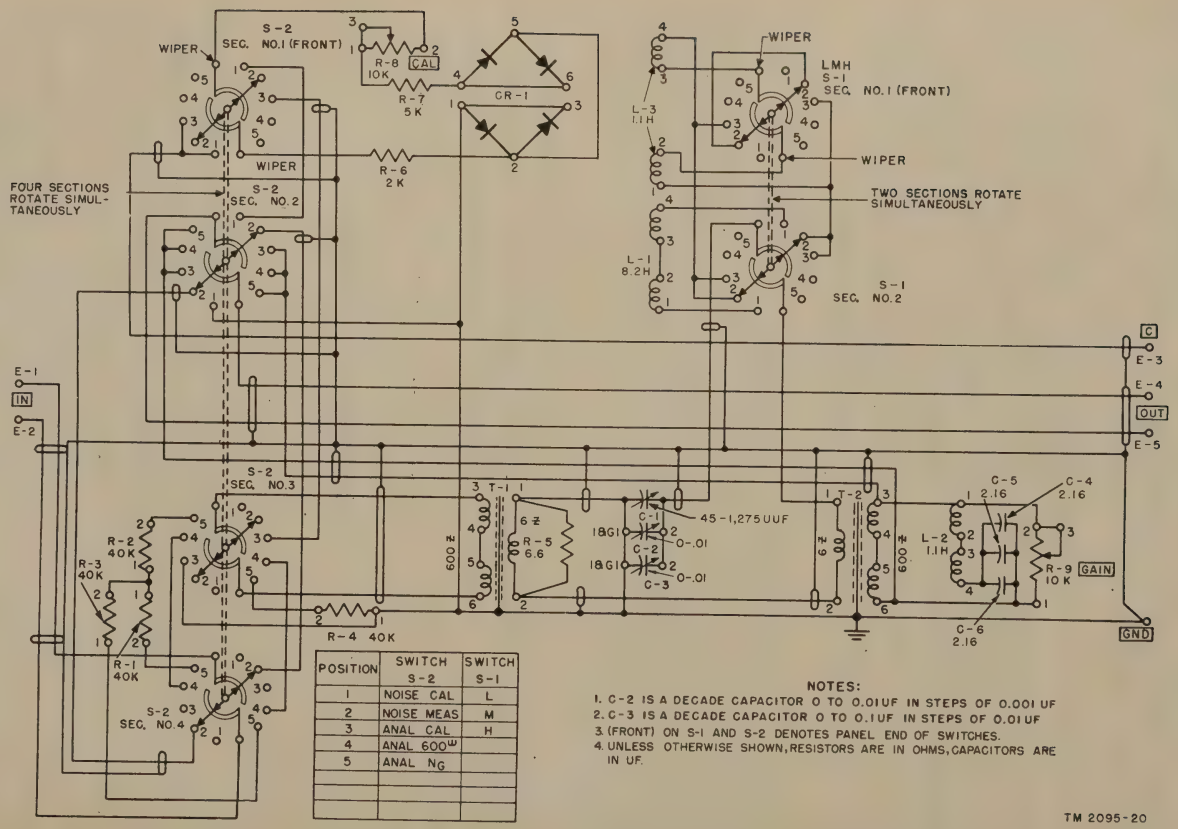
*d.* For noise measurements, the input and output terminals of TS–568/FT are connected directly together and to the input of TS–559/FT (fig. 10) as only TS–559/FT functions during a noise measurement.

## Section III. DISASSEMBLY PROCEDURES

### 33. Introduction

When a failure of a component of Transmission Measuring Set TS–568/FT makes replacement necessary, use the disassembly procedures given in the paragraphs below. The first step in any replacement procedure is to remove the front panel to which the chassis is fastened. Before removing the front panel, place the equipment on a table with the front panel facing upward. Remove three screws, two at the top right and left and one at the bottom center of the panel. Withdraw panel and chassis from case. Refer to figures 18 and 19 for location of components.

***Caution:*** Do not use control knobs and switch dials as handles or grips when withdrawing panel and chassis from case.




| POSITION | SWITCH S-2 | SWITCH S-1 |
|---|---|---|
| 1 | NOISE CAL | L |
| 2 | NOISE MEAS | M |
| 3 | ANAL CAL | H |
| 4 | ANAL 600Ω | |
| 5 | ANAL NG | |

NOTES:
1. C-2 IS A DECADE CAPACITOR 0 TO 0.01UF IN STEPS OF 0.001 UF
2. C-3 IS A DECADE CAPACITOR 0 TO 0.1UF IN STEPS OF 0.01 UF
3. (FRONT) ON S-1 AND S-2 DENOTES PANEL END OF SWITCHES.
4. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.

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*Figure 17. Transmission Measuring Set TS-568/FT, complete schematic.*

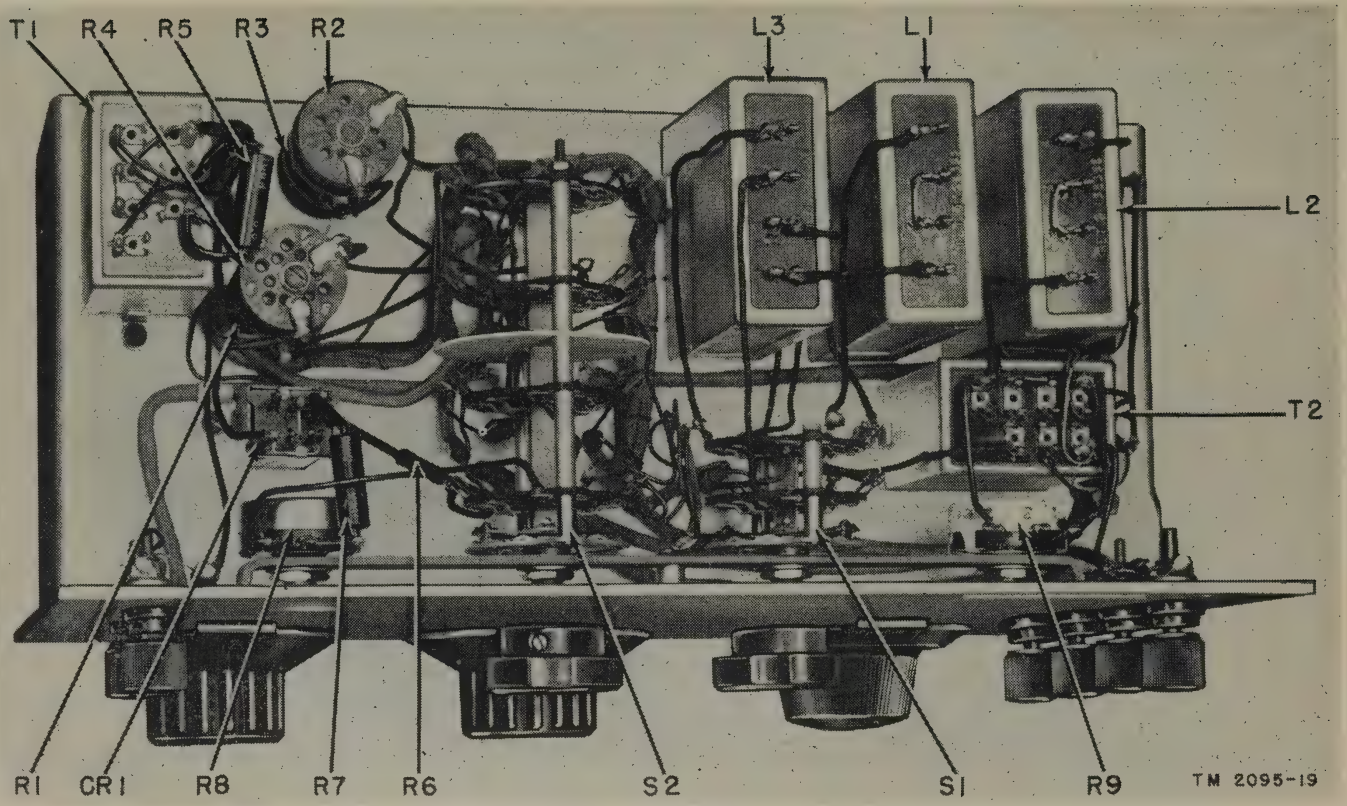


*Figure 18. Panel and chassis, front-top view.*

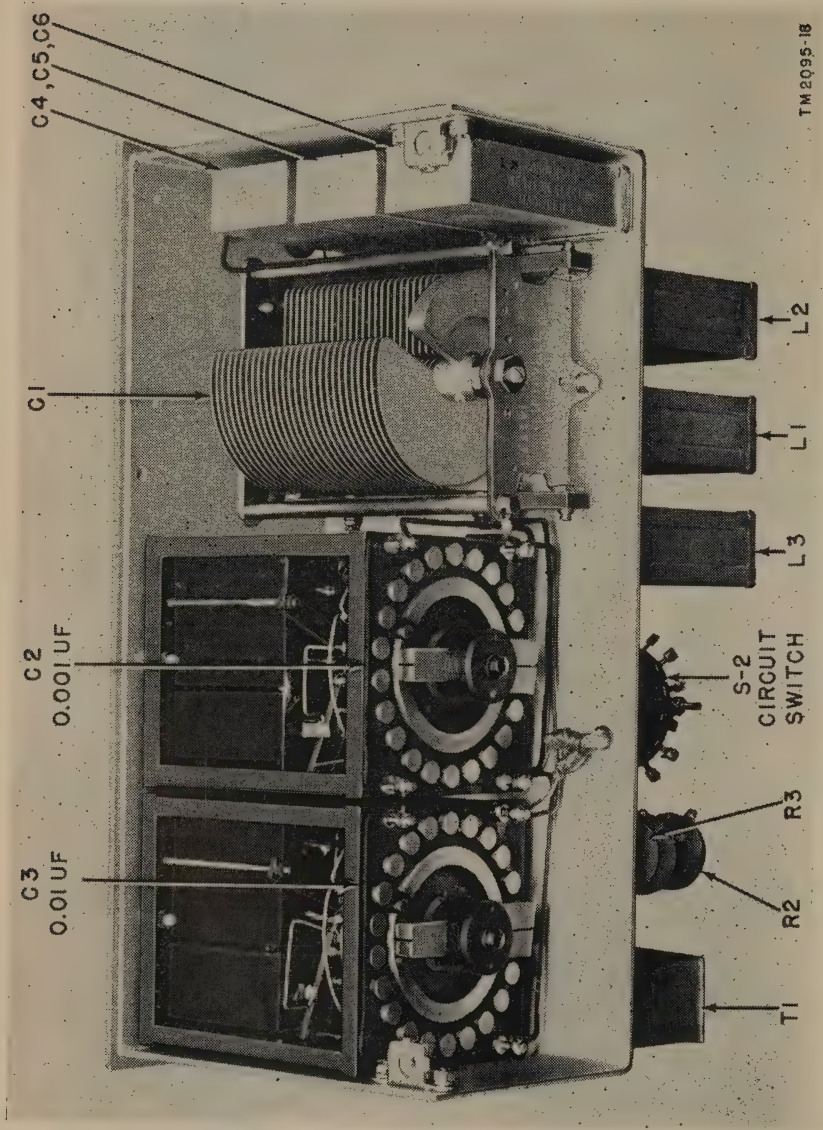


*Figure 19. Panel and chassis, top-rear view.*

## 34. Air Capacitor

To replace variable capacitor C–1—

*a.* Unsolder leads.

*b.* Remove screw from center of dial and lift dial from shaft.

*c.* When tuning dial is removed, the two screws holding air capacitor are exposed. Remove these screws, and the capacitor can be removed.

*d.* Reassembly is the reverse of disassembly, except that the capacitor must be fully closed when being replaced. After the capacitor is fastened in position, open it fully, replace the tuning dial, and set the dial at zero.

*e.* Recalibrate equipment after reassembly.

## 35. Switch Capacitors

Failure of one capacitor in the groups of 10 comprising C–2 or C–3 requires replacement of the entire unit of which it is a member. To remove switch capacitor—

*a.* Tag and unsolder leads.

*b.* Remove screw in center of switch dial, and remove dial from shaft. Unscrew threaded disk on dial shaft.

*c.* Remove screws fastening reference marker to front panel and remove marker.

*d.* Remove four screws holding capacitor unit to front panel.

*e.* Remove capacitor unit.

*f.* To reassemble, reverse the disassembly procedure.

*g.* Recalibrate equipment.

## 36. Fixed Capacitors

To replace fixed capacitor C–4, C–5, or C–6—

*a.* Tag and unsolder leads.

*b.* Remove two screws securing capacitor to chassis; remove capacitor.

*c.* To reassemble, reverse the disassembly procedure.

*d.* Recalibrate equipment.

## 37. Fixed Inductors and Transformers

To replace fixed inductor L–1, L–2, or L–3 or transformer T–1 or T–2—

*a.* Tag and unsolder leads.

*b.* Remove two screws securing inductor or transformer to chassis; remove inductor or transformer.

*c.* To reassemble, reverse the disassembly procedure.

*d.* Recalibrate equipment.

### 38. Resistors

*a.* To remove resistor R–1, R–2, R–3, or R–4—

(1) Unsolder leads.

(2) Remove concentric bolt and lift off resistor. If necessary, lift off other resistor and spacer, but do not remove leads from other resistor.

(3) To reassemble, reverse the disassembly procedure.

*b.* Resistors R–5, R–6, and R–7 are self-supported and merely need to be unsoldered to be removed.

### 39. Switches and Potentiometers

To remove potentiometer R–8 or R–9 or switch S–1 or S–2—

*a.* Tag and unsolder leads.

*b.* Remove knobs on switch S–1 and S–2 regardless of which switch or potentiometer has to be replaced.

*c.* Remove three bolts holding subpanel to main panel.

*d.* Remove ground lugs.

*e.* Turn subpanel to expose nut holding faulty component to subpanel.

*f.* Remove shaft nut and withdraw component.

*g.* To reassemble, reverse the disassembly procedure.

*h.* Recalibrate equipment.

### 40. Varistor

If any section of varistor CR–1 fails, the entire unit must be replaced in the following manner:

*a.* Tag and unsolder leads.

*b.* Remove two screws securing varistor to chassis; remove varistor.

*c.* To reassemble, reverse the disassembly procedure.

*d.* Recalibrate equipment.

# CHAPTER 5

# EQUIPMENT USED WITH TRANSMISSION MEASURING SET TS-568/FT

## 41. Transmission Measuring Set TS-559/FT

Transmission Measuring Set TS–559/FT, not supplied with Transmission Measuring Set TS–568/FT, is necessary for making tests and measurements. For a complete description and detailed information on the operation, maintenance, and repair of TS–559/FT, refer to the instruction book for Transmission Measuring Set TS–559/FT.

## 42. Voltage Analyzer Compensator CN-140/TT and Current Analyzer Compensator CN-141/TT

*a.* Voltage Analyzer Compensator CN–140/TT and Current Analyzer Compensator CN–141/TT are required to make tests and analyses of power circuits. Interfering noise is coupled to a telephone line by the distributed capacitance and the mutual inductance between the offending power source and the line. As a result, the coupling coefficient between the power system and the telephone line varies with frequency. In measurements of the TIF (telephone influence factor) of a particular power system, these varying coupling effects are simulated by means of the current or voltage compensator, respectively. The compensators are inserted between the power line and TS–568/FT and consist of reactive networks which provide a weighting factor increasing directly with frequency, thus representing the coupling between the power and telephone systems. The combined TS–568/FT and TS–559/FT sets introduce an additional weighting factor proportional to the relative interfering effects of single-frequency line noises. The composite weighting introduced by the compensators and the combined TS–568/FT and TS–559/FT sets represents the over-all telephone influence factor of the power system.

*b.* Voltage Analyzer Compensator CN–140/TT consists basically of a .01–$\mu$f capacitor connected in series with Transmission Measuring Set TS–568/FT across any alternating-current power line or potential transformer of 220 volts or less, or a direct-current circuit of less than 250 volts potential, or through suitable blocking capacitors across any direct-current system of more than 250 volts. The impedance of the capacitor is inversely proportional

to frequency, hence the voltage components applied to the combined transmission measuring sets are proportional to the voltage components on the power circuit multiplied by the respective frequencies. The schematic showing the voltage compensator connected to a power system is part of figure 14. The binding posts marked 110V are connected to the power circuit under test by use of the post marked GND SIDE to connect to the grounded side when grounded power circuits are involved. The binding posts marked TO SET are connected to the IN terminals of Transmission Measuring Set TS–568/FT. An instruction card, mounted on the top of the compensator panel, gives a diagram of connections, a set of instructions for connecting the compensator to the circuit under test and to the combined transmission measuring sets, and equations for converting the combined readings to Kv·T products for either the 1935 TIF or 1941 TIF weightings.

*c.* Current Analyzer Compensator CN–141/TT consists basically of a .4 mh reactor inserted in series with the secondary circuit of the current transformer connected to the power system (fig. 14). The voltage drop across the reactor is measured by the TS–568/FT and TS–559/FT combination. The impedance of the reactor is proportional to frequency, and thus the voltage components appearing across the reactor are proportional to the current components multiplied by their respective frequencies. The method of connecting the current compensator is illustrated in figure 14. The pair of binding posts marked TO C.T. SEC. are connected to the secondary of the current transformer in the power circuit under test. The binding post marked GND is connected as near to ground potential as possible. The set of binding posts marked TO SET are connected to the IN terminals of Transmission Measuring Set TS–568/FT. Holes in the brackets at the end of the wooden base are provided to admit wires to be connected to the binding posts. The duralumin cover fits down over and clips to the end brackets. Inside the cover is mounted a chart giving a diagram of connections, a set of instructions for connecting the compensator to Transmission Measuring Set TS–568/FT and current transformer, equations for converting the combined readings of the transmission measuring sets to corresponding I·T products, and graphs of the relations between these readings and I·T products given by the equations.

*Note.* The cover must always be in place when the compensator is in use, because it affects the impedance of the reactor coil and consequently the calibration of the apparatus.

***Caution:*** Currents in excess of 5 amperes will damage the coil and must be avoided.

## 43. Switches

Two double-pole, double-throw and one single-pole, single-throw knife switches are required to make the measurement connections. These connections are shown in figures 8 and 14.

# CHAPTER 6

# SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

## Section I. SHIPMENT AND LIMITED STORAGE

### 44. Packaging Transmission Measuring Set TS-568/FT

Cushion the set on all surfaces with cells or pads fabricated of corrugated fiberboard. Obtain the proper amount of desiccant, as prescribed in table II, section E of Joint Army-Navy Specification JAN–P–116, and place the cushioned set, together with technical manuals and desiccant, within a close-fitting regular slotted style corrugated fiberboard box. Seal the entire closure with gummed Kraft tape and blunt all corners of the box. Place the boxed set within a moisture-vaporproofed barrier, type I, and heat-seal the closure. Place the moisture-vaporproofed set within a second close-fitting regular slotted style corrugated fiberboard box and seal the entire closure with water-resistant tape or adhesive. Overwrap the boxed set in waterproof barrier material, type L–2 or M. Completely seal all joints, seams, and closures with adhesive or other suitable seal equal in moisture resistance to that of the body material, in accordance with approved specifications.

### 45. Packing

Materials used in packing described in the following subparagraphs should comply with requirements in Joint Army-Navy Specification JAN–P–100.

*a.* Place the equipment, packaged as described in paragraph 44, within a nailed wooden box lined inside with a 2-inch thickness of excelsior compacted to 3 pounds per cubic foot. The shipping container should *not* be lined with a waterproof bag.

*b.* For oversea shipment only, the shipping container should be strapped in accordance with approved specifications.

### 46. Marking

Signal Corps depots should mark interior packages in accordance with Signal Corps Instruction No. 726–15, and shipping containers in accordance with Signal Corps Instruction No. 720–14.

## Section II. DEMOLITION TO PREVENT ENEMY USE

### 47. Methods of Demolition

*a.* SMASH. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

*b.* CUT. Use axes, handaxes, machetes.

*c.* BURN. Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

*d.* EXPLODE. Use firearms, grenades, TNT.

*e.* DISPOSE. Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

*Note.* Use anything immediately available for destruction of this equipment.

### 48. Destruction of Components

When ordered by the commander, destroy all equipment to prevent its being used or salvaged by the enemy.

*a. Smash* panel and controls, capacitors, reactors, rectifiers, resistors, shaft, switches, transformers, etc.

*b. Cut* all wiring in electrical circuits.

*c. Burn* all instruction books, circuits, etc.

*d. Bury or scatter* all remaining parts of the equipment.

*e. Destroy everything.*

# TABLE I

## APPROXIMATE RANGE OF QUANTITIES MEASURABLE WITH TRANSMISSION MEASURING SET TS-568/FT, TRANSMISSION MEASURING SET TS-559/FT*, AND ANALYZER COMPENSATORS

| RANGE | FREQ | SUM OF DIAL AND METER READING IN DB | MCA IN 600 OHMS ($I_M$) | VOLTS ACROSS 100,000 OHMS ($V_G$) | MILS IN C COMPENSATORS | VOLTS ACROSS V COMPENSATORS |
|---|---|---|---|---|---|---|
| L | 180* | 10 | 1.6 | 0.16 | 4.2 | 0.29 |
| | | 75 | 2,800.0 | 280.00a | 7,500.0 | 520.00b |
| | 540 | 10 | 1.7 | 0.17 | 1.6 | 0.10 |
| | | 75 | 3,000.0 | 300.00 | 2,850.0 | 180.00 |
| M | 540 | 10 | 0.36 | 0.036 | 0.32 | 0.02 |
| | | 75 | 640.00 | 64.000 | 570.00 | 36.00 |
| | 1,500 | 10 | 0.39 | 0.039 | 0.13 | 0.008 |
| | | 75 | 700.00 | 70.000 | 230.00 | 14.000 |
| H | 1,500 | 10 | 0.13 | 0.013 | 0.04 | 0.0025 |
| | | 75 | 230.00 | 230.000 | 71.00 | 4.5000 |
| | 3,000 | 10 | 0.17 | 0.017 | 0.029 | 0.0018 |
| | | 75 | 300.00 | 30.000 | 50.000 | 3.2000 |
| | 4,000 | 10 | 0.23 | 0.023 | 0.03 | 0.0019 |
| | | 75 | 410.00 | 41.000 | 54.00 | 3.4000 |

a VOLTAGES HIGHER THAN 120 VOLTS SHOULD NOT BE IMPRESSED ON TS-568/FT TERMINALS BECAUSE OF INSULATION LIMITATIONS.

b VOLTAGES HIGHER THAN 250 VOLTS SHOULD NOT BE IMPRESSED ON VOLTAGE COMPENSATORS.

## TABLE II

### ARRANGEMENTS FOR VARIOUS TYPES OF MEASUREMENT WITH TRANSMISSION MEASURING SET TS-568/FT AND TRANSMISSION MEASURING SET TS-559/FT

| OPERATION | WEIGHTING | CIRCUIT SWITCH OF TRANSMISSION MEASURING SET TS-568/FT | TRANSMISSION MEASURING SET TS-559/FT | | |
|---|---|---|---|---|---|
| | | | INPUT PLUG | KEY K3 | KEY K4 |
| CALIBRATING TS-559/FT | | NOISE CAL | LINE | NORMAL | 144 |
| MEASURING NM. I-T. KV-T | 144 LINE<br>1935 TIF | NOISE MEAS | LINE | NORMAL | 144 |
| | F1A LINE<br>TENT. 1941 TIF | NOISE MEAS | LINE | NORMAL | F1A-HA1 |
| MEASURING NOISE-TO-GROUND | 144 LINE | NOISE MEAS | N-GND | NORMAL | 144 |
| | F1A LINE | NOISE MEAS | N-GND | NORMAL | F1A-HA1 |
| CALIBRATING TS-568/FT | FLAT | ANAL CAL (TUNED FOR 1020 CYCLES M-2-1-80) | LINE & DUMMY PLUGS IN SOUND | FLAT | 144 |
| ANALYZING NOISE-METALLIC. POWER CURRENT OR VOLTAGE | FLAT | ANAL 600 | LINE & DUMMY PLUGS IN SOUND | FLAT | 144 |
| ANALYZING NOISE-TO-GROUND | FLAT | ANAL $N_G$ | LINE & DUMMY PLUGS IN SOUND | FLAT | 144 |

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# TABLE III

## CALIBRATION OF TYPICAL TRANSMISSION MEASURING SET TS-568/FT WITH TYPICAL TRANSMISSION MEASURING SET TS-559/FT

DATE OF CALIBRATION: JUNE 28, 1940.
TS-559/FT PLUG IN LINE JACKS,
DUMMY PLUGS IN SOUND, KEY K3 TO FLAT.

CALIBRATION CONSTANTS

| FREQ | FREQ SETTING | | | | DB FOR 1 MCA IN 600ω | DB FOR 1 VOLT TO GROUND | DB FOR 10 MILS IN CURRENT COMPENSATOR | DB FOR 1 VOLT ACROSS VOLTAGE COMPENSATOR |
|---|---|---|---|---|---|---|---|---|
| | RANGE | CAPACITOR SETTING | | | | | | |
| | | 0.01 | 0.001 | AIR | | | | |
| 180 | L | 9 | 7 | 43 | 5.5 | 25.5 | 18.6 | 21.4 |
| 300 | L | 3 | 4 | 70 | 5.4 | 25.4 | 23.0 | 26.0 |
| 420 | L | 1 | 7 | 40 | 5.0 | 25.0 | 25.1 | 28.4 |
| 540 | L | 1 | 0 | 37 | 4.4 | 24.4 | 26.6 | 29.8 |
| 540 | M | 7 | 9 | 41 | 18.7 | 38.7 | 41.0 | 44.2 |
| 660 | M | | | | | | | |
| 780 | M | 3 | 7 | 86 | 18.9 | 38.9 | 43.8 | 47.0 |
| 900 | M | | | | CAL | | | |
| 1,020 | M | 2 | 1 | 84 | SETTING 17.8 | 37.8 | 45.5 | 48.9 |
| 1,140 | M | | | | 30 DB | | | |
| 1,260 | M | 1 | 4 | 24 | RED LINE 17.2 | 37.2 | 46.7 | 50.0 |
| 1,380 | M | | | | | | | |
| 1,500 | M | 0 | 9 | 80 | 16.5 | 36.5 | 47.3 | 50.8 |
| 1,500 | H | 4 | 0 | 71 | 26.6 | 46.6 | 58.1 | 61.5 |
| 1,620 | H | | | | | | | |
| 1,740 | H | 3 | 0 | 26 | 26.2 | 46.2 | 59.0 | 62.3 |
| 1,860 | H | | | | | | | |
| 1,980 | H | | | | | | | |
| 2,100 | H | 2 | 0 | 54 | 25.5 | 45.5 | 59.8 | 63.3 |
| 2,220 | H | | | | | | | |
| 2,340 | H | | | | | | | |
| 2,460 | H | 1 | 4 | 88 | 24.8 | 44.8 | 60.2 | 63.8 |
| 2,580 | H | | | | | | | |
| 2,700 | H | 1 | 1 | 91 | 24.3 | 44.3 | 60.4 | 63.9 |
| 2,820 | H | | | | | | | |
| 2,940 | H | | | | | | | |
| 3,000 | H | 0 | 9 | 64 | 23.6 | 43.6 | 60.4 | 63.9 |
| 3,180 | H | | | | | | | |
| 3,300 | H | 0 | 7 | 76 | 22.8 | 42.8 | 60.3 | 63.8 |
| 3,540 | H | | | | | | | |
| 3,660 | H | | | | | | | |
| 3,900 | H | 0 | 5 | 49 | 20.4 | 40.4 | 59.5 | 63.0 |

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# TABLE IV

## SAMPLE DATA SHEET SHOWING CALCULATIONS OF INDIVIDUAL HARMONIC COMPONENTS TO TOTAL NOISE, VOLTAGE TIF OR I•T

(DATA WORKED UP USING CALIBRATION CHART, TABLE III, AND DB-CURRENT RATIO, TABLE VII)

| | | | NOISE-METALLIC | | | | NOISE-TO-GROUND | | | | 120-VOLT VOLTAGE | | | | PHASE CURRENT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MEASURED TOTAL | FREQ | CAPACITOR SETTINGS | DB | MCA | NU/MCA | NU | DB | VOLTS | NU/VOLT | NU | DB | VOLTS | TIF WTG | TIF [a] | DB | MILS | TIF WTG/1000 | SEC I•T [b] |
| | | | 26.0 | | | 140.0 | 43.0 | | | 1,000.0 | 46.0 | KV•T= | 3.0 | 25.0 | 71.0 | | | 800.0 |
| | 60 C | | | | | | | | | | | 121.0 | 1.0 | 1.0 | | 4,200.0 | 0.001 | 4.2 |
| | 180 | L 9 7 30 | 39.8 | 52.0 | 1.2 | 62.0 | 30.1 | 1.7 | 12.0 | 20.0 | 39.6 | 8.1 | 15.0 | 1.0 | 49.0 | 330.0 | 0.015 | 5.0 |
| | 300 | L 3 4 50 | 17.5 | 4.0 | 10.0 | 40.0 | 35.0 | 3.0 | 100.0 | 300.0 | 35.6 | 3.0 | 205.0 | 5.0 | 57.0 | 500.0 | 0.200 | 100.0 |
| | 420 | | | | | | | | | | | | | | | | | |
| | 540 | M 7 9 10 | 21.6 | 1.4 | 22.0 | 50.0 | 39.5 | 1.1 | 220.0 | 400.0 | 43.9 | 0.97 | 590.0 | 10.0 | 65.1 | 160.0 | 0.59 | 200.0 |
| | 660 | | | | 36.0 | | | | 360.0 | | | | 1,250.0 | | | | 1.25 | |
| | | | | | 53.0 | | | | 530.0 | | | | 2,250.0 | | | | 2.25 | |
| | 780 | | | | | | | | | | | | | | | | | |
| | 900 | | | | 80.0 | | | | 800.0 | | | | 4,080.0 | | | | 4.08 | |
| | 1,020 | M 2 1 20 | 8.8 | 0.35 | 124.0 | 60.0 | 28.4 | 0.34 | 1,240.0 | 600.0 | 33.0 | 0.16 | 7,270.0 | 15.0 | 58.2 | 43.0 | 7.27 | 500.0 |
| | | | | | 174.0 | | | | 1,740.0 | | | | 11,600.0 | | | | 11.60 | |
| | 1,140 | | | | | | | | | | | | | | | | | |
| | 1,260 | | 11.2 | 0.47 | 149.0 | 70.0 | 28.4 | 0.34 | 1,490.0 | 500.0 | 29.7 | 0.11 | 11,100.0 | 10.0 | 56.6 | 36.0 | 11.1 | 400.0 |
| | 1,380 | | | | 96.0 | | | | 960.0 | | | | 7,920.0 | | | | 7.9 | |
| | | | | | 60.0 | | | | 600.0 | | | | 5,470.0 | | | | 5.5 | |
| | 1,500 | M 0 9 50 | 9.2 | 0.44 | 45.0 | 20.0 | 23.4 | 0.22 | 450.0 | 100.0 | 39.4 | 0.27 | 4,400.0 | 10.0 | 64.0 | 68.0 | 4.4 | 300.0 |
| CHECK MEASURED TOTAL | | | 25.5 | | | 130.0 | 44.0 | | | 1,100.0 | 46.0 | KV•T= | 3.0 | 25.0 | 70.5 | | | 750.0 |
| CHECK 60 C RMS OF INDIVIDUAL COMPONENT | | | | | | 120.0 | | | | 940.0 | | 120.0 | 1.0 | 1.0 | | 4,100.0 | 0.001 | 4.1 |
| | | | | | | | | | | | | | | 24.0 | | | | 750.0 |

[a] TIF CONTRIBUTION = $\frac{V_{HARMONIC}}{V_{RMS}}$ X TIF WEIGHTING (1935).

[b] I•T CONTRIBUTION = MILS X $\frac{\text{TIF WEIGHTING (1935)}}{1000}$. SECONDARY I•T ASSUMES CURRENT COMPENSATING ANALYZER IS USED IN SECONDARY OF CURRENT TRANSFORMER: PRIMARY I•T IS GIVEN BY PRODUCT OF SECONDARY I•T AND CURRENT TRANSFORMER RATIO.

[c] RMS VALUES MEASURED WITH ALTERNATING CURRENT AMMETER AND VOLTMETER.

# TABLE V

## SAMPLE CALCULATIONS OF INDIVIDUAL FREQUENCY CONTRIBUTIONS TO TELEPHONE CIRCUIT NOISE ON DBA BASIS

| FREQ (CYCLES) | $(C_F)$ (DB) | $(W_F)$ (DB) | $(F_F)$ [a] (DB) | NOISE-METALLIC $(R_F)$ (DB) | NOISE-METALLIC $(N_M)$ [b] (DBA) | NOISE-METALLIC POWER RATIO [c] | NOISE-TO-GROUND $(R_F)$ (DB) | NOISE-TO-GROUND $(N_G)$ [b] (DBA) | NOISE-TO-GROUND POWER RATIO [c] |
|---|---|---|---|---|---|---|---|---|---|
| 180 | 5.5 | 43.0 | -20.7 | 39.8 | 19.1 | 81.3 | 30.1 | 9.4 | 9 |
| 300 | 5.4 | 24.5 | - 2.1 | 17.5 | 15.4 | 34.7 | 35.0 | 32.9 | 1,950 |
| 540 | 18.7 | 14.0 | - 4.9 | 21.6 | 16.7 | 46.8 | 39.5 | 34.6 | 2,880 |
| 1,020 | 17.8 | 0.1 | + 9.9 | 8.8 | 18.7 | 74.1 | 28.4 | 38.3 | 6,760 |
| 1,140 | 17.8 | 1.5 | + 8.5 | 11.2 | 19.7 | 93.3 | 28.4 | 36.9 | 4,900 |
| 1,500 | 16.5 | 11.7 | - 0.4 | 9.2 | 8.8 | 7.6 | 23.4 | 23.0 | 200 |
| | | | | | | 337.8 | | | 16,699 |
| | | | | RSS TOTAL DBA | 25.3 | | | 42.2 | |
| | | | | MEASURED NOISE DBA | 26.0 | | | 43.0 | |

[a] $F_F = 27.8 - W_F - C_F$.

[b] $N_M$ (OR $N_G$) $= R_F + F_F$.

[c] POWER RATIOS CORRESPONDING TO $N_M$ OR $N_G$ IN DB.

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# TABLE VI

## RELATIONSHIP BETWEEN DB AND POWER RATIO

| DB | $P_1/P_2$ | $P_2/P_1$ |
|---|---|---|
| 0.1 | 1.023 | 0.977 |
| 0.2 | 1.047 | 0.955 |
| 0.3 | 1.072 | 0.933 |
| 0.4 | 1.096 | 0.912 |
| 0.5 | 1.122 | 0.891 |
| 0.6 | 1.148 | 0.871 |
| 0.7 | 1.175 | 0.851 |
| 0.8 | 1.202 | 0.832 |
| 0.9 | 1.230 | 0.813 |
| 1.0 | 1.259 | 0.794 |
| 1.1 | 1.288 | 0.776 |
| 1.2 | 1.318 | 0.759 |
| 1.3 | 1.349 | 0.741 |
| 1.4 | 1.380 | 0.724 |
| 1.5 | 1.413 | 0.708 |
| 1.6 | 1.445 | 0.692 |
| 1.7 | 1.479 | 0.676 |
| 1.8 | 1.514 | 0.661 |
| 1.9 | 1.549 | 0.645 |
| 2.0 | 1.585 | 0.631 |
| 2.1 | 1.622 | 0.617 |
| 2.2 | 1.660 | 0.603 |
| 2.3 | 1.698 | 0.589 |
| 2.4 | 1.738 | 0.575 |
| 2.5 | 1.778 | 0.562 |
| 2.6 | 1.820 | 0.550 |
| 2.7 | 1.862 | 0.537 |
| 2.8 | 1.906 | 0.525 |
| 2.9 | 1.950 | 0.513 |
| 3.0 | 1.995 | 0.501 |
| 3.1 | 2.04 | 0.490 |
| 3.2 | 2.09 | 0.479 |
| 3.3 | 2.14 | 0.468 |
| 3.4 | 2.19 | 0.457 |
| 3.5 | 2.24 | 0.447 |
| 3.6 | 2.29 | 0.437 |
| 3.7 | 2.34 | 0.427 |
| 3.8 | 2.40 | 0.417 |
| 3.9 | 2.45 | 0.407 |
| 4.0 | 2.51 | 0.398 |
| 4.1 | 2.57 | 0.389 |
| 4.2 | 2.63 | 0.380 |
| 4.3 | 2.69 | 0.372 |
| 4.4 | 2.75 | 0.363 |
| 4.5 | 2.82 | 0.355 |
| 4.6 | 2.88 | 0.347 |
| 4.7 | 2.95 | 0.339 |
| 4.8 | 3.02 | 0.331 |
| 4.9 | 3.09 | 0.324 |
| 5.0 | 3.16 | 0.316 |

| DB | $P_1/P_2$ | $P_2/P_1$ |
|---|---|---|
| 5.1 | 3.24 | 0.309 |
| 5.2 | 3.31 | 0.302 |
| 5.3 | 3.39 | 0.295 |
| 5.4 | 3.47 | 0.288 |
| 5.5 | 3.55 | 0.282 |
| 5.6 | 3.63 | 0.275 |
| 5.7 | 3.72 | 0.269 |
| 5.8 | 3.80 | 0.263 |
| 5.9 | 3.89 | 0.257 |
| 6.0 | 3.98 | 0.251 |
| 6.1 | 4.07 | 0.245 |
| 6.2 | 4.17 | 0.240 |
| 6.3 | 4.27 | 0.234 |
| 6.4 | 4.37 | 0.229 |
| 6.5 | 4.47 | 0.224 |
| 6.6 | 4.57 | 0.219 |
| 6.7 | 4.68 | 0.214 |
| 6.8 | 4.79 | 0.209 |
| 6.9 | 4.90 | 0.204 |
| 7.0 | 5.01 | 0.200 |
| 7.1 | 5.13 | 0.195 |
| 7.2 | 5.25 | 0.191 |
| 7.3 | 5.37 | 0.186 |
| 7.4 | 5.50 | 0.182 |
| 7.5 | 5.62 | 0.178 |
| 7.6 | 5.75 | 0.174 |
| 7.7 | 5.89 | 0.170 |
| 7.8 | 6.03 | 0.166 |
| 7.9 | 6.17 | 0.162 |
| 8.0 | 6.31 | 0.158 |
| 8.1 | 6.45 | 0.155 |
| 8.2 | 6.61 | 0.151 |
| 8.3 | 6.76 | 0.148 |
| 8.4 | 6.92 | 0.144 |
| 8.5 | 7.08 | 0.141 |
| 8.6 | 7.24 | 0.138 |
| 8.7 | 7.41 | 0.135 |
| 8.8 | 7.59 | 0.132 |
| 8.9 | 7.76 | 0.129 |
| 9.0 | 7.94 | 0.126 |
| 9.1 | 8.13 | 0.123 |
| 9.2 | 8.32 | 0.120 |
| 9.3 | 8.51 | 0.118 |
| 9.4 | 8.71 | 0.115 |
| 9.5 | 8.91 | 0.112 |
| 9.6 | 9.12 | 0.110 |
| 9.7 | 9.33 | 0.107 |
| 9.8 | 9.55 | 0.105 |
| 9.9 | 9.77 | 0.102 |
| 10.0 | 10.00 | 0.100 |

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# TABLE VII

## RELATION BETWEEN DB AND CURRENT RATIO

| DB | $I_1/I_2$ | $I_2/I_1$ |
|---|---|---|
| 0.1 | 1.012 | 0.989 |
| 0.2 | 1.023 | 0.977 |
| 0.3 | 1.035 | 0.966 |
| 0.4 | 1.047 | 0.955 |
| 0.5 | 1.059 | 0.944 |
| 0.6 | 1.072 | 0.933 |
| 0.7 | 1.084 | 0.923 |
| 0.8 | 1.096 | 0.912 |
| 0.9 | 1.109 | 0.902 |
| 1.0 | 1.122 | 0.891 |
| 1.1 | 1.135 | 0.881 |
| 1.2 | 1.148 | 0.871 |
| 1.3 | 1.162 | 0.861 |
| 1.4 | 1.175 | 0.851 |
| 1.5 | 1.188 | 0.841 |
| 1.6 | 1.202 | 0.832 |
| 1.7 | 1.216 | 0.822 |
| 1.8 | 1.230 | 0.813 |
| 1.9 | 1.245 | 0.804 |
| 2.0 | 1.259 | 0.794 |
| 2.1 | 1.274 | 0.785 |
| 2.2 | 1.288 | 0.776 |
| 2.3 | 1.303 | 0.767 |
| 2.4 | 1.318 | 0.759 |
| 2.5 | 1.334 | 0.750 |
| 2.6 | 1.349 | 0.741 |
| 2.7 | 1.365 | 0.733 |
| 2.8 | 1.380 | 0.724 |
| 2.9 | 1.396 | 0.716 |
| 3.0 | 1.413 | 0.708 |
| 3.1 | 1.429 | 0.700 |
| 3.2 | 1.445 | 0.692 |
| 3.3 | 1.462 | 0.684 |
| 3.4 | 1.479 | 0.676 |
| 3.5 | 1.496 | 0.668 |
| 3.6 | 1.514 | 0.661 |
| 3.7 | 1.531 | 0.653 |
| 3.8 | 1.549 | 0.645 |
| 3.9 | 1.567 | 0.638 |
| 4.0 | 1.585 | 0.631 |
| 4.1 | 1.603 | 0.624 |
| 4.2 | 1.622 | 0.617 |
| 4.3 | 1.641 | 0.610 |
| 4.4 | 1.660 | 0.603 |
| 4.5 | 1.679 | 0.596 |
| 4.6 | 1.698 | 0.589 |
| 4.7 | 1.718 | 0.582 |
| 4.8 | 1.738 | 0.575 |
| 4.9 | 1.758 | 0.569 |
| 5.0 | 1.778 | 0.562 |
| 5.1 | 1.799 | 0.556 |
| 5.2 | 1.820 | 0.550 |
| 5.3 | 1.841 | 0.543 |
| 5.4 | 1.862 | 0.537 |
| 5.5 | 1.884 | 0.531 |
| 5.6 | 1.906 | 0.525 |
| 5.7 | 1.928 | 0.519 |
| 5.8 | 1.950 | 0.513 |
| 5.9 | 1.972 | 0.507 |
| 6.0 | 1.995 | 0.501 |
| 6.1 | 2.018 | 0.495 |
| 6.2 | 2.04 | 0.490 |
| 6.3 | 2.06 | 0.484 |
| 6.4 | 2.09 | 0.479 |
| 6.5 | 2.11 | 0.473 |
| 6.6 | 2.14 | 0.468 |
| 6.7 | 2.16 | 0.462 |
| 6.8 | 2.19 | 0.457 |
| 6.9 | 2.21 | 0.452 |
| 7.0 | 2.24 | 0.447 |
| 7.1 | 2.26 | 0.442 |
| 7.2 | 2.29 | 0.437 |
| 7.3 | 2.32 | 0.432 |
| 7.4 | 2.34 | 0.427 |
| 7.5 | 2.37 | 0.422 |
| 7.6 | 2.40 | 0.417 |
| 7.7 | 2.42 | 0.412 |
| 7.8 | 2.45 | 0.407 |
| 7.9 | 2.48 | 0.403 |
| 8.0 | 2.51 | 0.398 |
| 8.1 | 2.54 | 0.394 |
| 8.2 | 2.57 | 0.389 |
| 8.3 | 2.60 | 0.385 |
| 8.4 | 2.63 | 0.380 |
| 8.5 | 2.66 | 0.376 |
| 8.6 | 2.69 | 0.372 |
| 8.7 | 2.72 | 0.367 |
| 8.8 | 2.75 | 0.363 |
| 8.9 | 2.79 | 0.359 |
| 9.0 | 2.82 | 0.355 |
| 9.1 | 2.85 | 0.351 |
| 9.2 | 2.88 | 0.347 |
| 9.3 | 2.91 | 0.343 |
| 9.4 | 2.95 | 0.339 |
| 9.5 | 2.98 | 0.335 |
| 9.6 | 3.02 | 0.331 |
| 9.7 | 3.05 | 0.327 |
| 9.8 | 3.09 | 0.324 |
| 9.9 | 3.13 | 0.320 |
| 10.0 | 3.16 | 0.316 |
| 10.1 | 3.20 | 0.313 |
| 10.2 | 3.24 | 0.309 |
| 10.3 | 3.27 | 0.305 |
| 10.4 | 3.31 | 0.302 |
| 10.5 | 3.35 | 0.298 |
| 10.6 | 3.39 | 0.295 |
| 10.7 | 3.43 | 0.291 |
| 10.8 | 3.47 | 0.288 |
| 10.9 | 3.51 | 0.285 |
| 11.0 | 3.55 | 0.282 |
| 11.1 | 3.59 | 0.279 |
| 11.2 | 3.63 | 0.275 |
| 11.3 | 3.67 | 0.272 |
| 11.4 | 3.72 | 0.269 |
| 11.5 | 3.76 | 0.266 |
| 11.6 | 3.80 | 0.263 |
| 11.7 | 3.85 | 0.260 |
| 11.8 | 3.89 | 0.257 |
| 11.9 | 3.94 | 0.254 |
| 12.0 | 3.98 | 0.251 |
| 12.1 | 4.03 | 0.248 |
| 12.2 | 4.07 | 0.245 |
| 12.3 | 4.12 | 0.242 |
| 12.4 | 4.17 | 0.240 |
| 12.5 | 4.22 | 0.237 |
| 12.6 | 4.27 | 0.234 |
| 12.7 | 4.32 | 0.232 |
| 12.8 | 4.37 | 0.229 |
| 12.9 | 4.42 | 0.226 |
| 13.0 | 4.47 | 0.224 |
| 13.1 | 4.52 | 0.221 |
| 13.2 | 4.57 | 0.219 |
| 13.3 | 4.62 | 0.216 |
| 13.4 | 4.68 | 0.214 |
| 13.5 | 4.73 | 0.211 |
| 13.6 | 4.79 | 0.209 |
| 13.7 | 4.84 | 0.206 |
| 13.8 | 4.90 | 0.204 |
| 13.9 | 4.95 | 0.202 |
| 14.0 | 5.01 | 0.200 |
| 14.1 | 5.07 | 0.197 |
| 14.2 | 5.13 | 0.195 |
| 14.3 | 5.19 | 0.193 |
| 14.4 | 5.25 | 0.191 |
| 14.5 | 5.31 | 0.188 |
| 14.6 | 5.37 | 0.186 |
| 14.7 | 5.43 | 0.184 |
| 14.8 | 5.50 | 0.182 |
| 14.9 | 5.56 | 0.180 |
| 15.0 | 5.62 | 0.178 |
| 15.1 | 5.69 | 0.176 |
| 15.2 | 5.75 | 0.174 |
| 15.3 | 5.82 | 0.172 |
| 15.4 | 5.89 | 0.170 |
| 15.5 | 5.96 | 0.168 |
| 15.6 | 6.03 | 0.166 |
| 15.7 | 6.10 | 0.164 |
| 15.8 | 6.17 | 0.162 |
| 15.9 | 6.24 | 0.160 |
| 16.0 | 6.31 | 0.158 |
| 16.1 | 6.38 | 0.157 |
| 16.2 | 6.45 | 0.155 |
| 16.3 | 6.53 | 0.153 |
| 16.4 | 6.61 | 0.151 |
| 16.5 | 6.68 | 0.150 |
| 16.6 | 6.76 | 0.148 |
| 16.7 | 6.84 | 0.146 |
| 16.8 | 6.92 | 0.144 |
| 16.9 | 7.00 | 0.143 |
| 17.0 | 7.08 | 0.141 |
| 17.1 | 7.16 | 0.140 |
| 17.2 | 7.24 | 0.138 |
| 17.3 | 7.33 | 0.136 |
| 17.4 | 7.41 | 0.135 |
| 17.5 | 7.50 | 0.133 |
| 17.6 | 7.59 | 0.132 |
| 17.7 | 7.67 | 0.130 |
| 17.8 | 7.76 | 0.129 |
| 17.9 | 7.85 | 0.127 |
| 18.0 | 7.94 | 0.126 |
| 18.1 | 8.04 | 0.124 |
| 18.2 | 8.13 | 0.123 |
| 18.3 | 8.22 | 0.122 |
| 18.4 | 8.32 | 0.120 |
| 18.5 | 8.41 | 0.119 |
| 18.6 | 8.51 | 0.118 |
| 18.7 | 8.61 | 0.116 |
| 18.8 | 8.71 | 0.115 |
| 18.9 | 8.81 | 0.114 |
| 19.0 | 8.91 | 0.112 |
| 19.1 | 9.02 | 0.011 |
| 19.2 | 9.12 | 0.110 |
| 19.3 | 9.23 | 0.108 |
| 19.4 | 9.33 | 0.107 |
| 19.5 | 9.44 | 0.106 |
| 19.6 | 9.55 | 0.105 |
| 19.7 | 9.66 | 0.194 |
| 19.8 | 9.77 | 0.102 |
| 19.9 | 9.89 | 0.101 |
| 20.0 | 10.00 | 0.100 |

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# APPENDIX II

# REFERENCES

*Note.* For availability of items listed, check SR 310-20-3, SR 310-20-4, and Department of the Army Supply Catalog SIG 1.

## 1. Military (JAN) Specifications

| | |
|---|---|
| JAN–P–658 | Packaging and packing of electrical equipment and spare parts (electronic, electrical, and electro-mechanical). |
| JAN–B–121 | Barrier-materials, greaseproof. |
| JAN–C–149 | Compound, protective, strippable (hot dipping). |
| JAN–D–169 | Desiccants (activated). |
| JAN–P–100 | Packaging and packing for overseas shipment—general specification. |
| JAN–P–101 | Packaging and packing for overseas shipment—Adhesive, water-resistant, for sealing fiberboard boxes. |
| JAN–P–102 | Packaging and packing for overseas shipment—Composition topcoating materials, bituminous. |
| JAN–P–103 | Packaging and packing for overseas shipment—Boxes; wood-cleated; solid fiberboard. |
| JAN–P–104 | Packaging and packing for overseas shipment—Crates; sheathed, wood, nailed. |
| JAN–P–105A | Packaging and packing for overseas shipment—Boxes; wood, cleated, plywood. |
| JAN–P–106A | Packaging and packing for overseas shipment—Boxes; wood, nailed. |
| JAN–P–108 | Packaging and packing for overseas shipment—Boxes; fiberboard (V-board and W-board), exterior and interior. |
| JAN–P–115 | Packaging and packing for overseas shipment—Compound, sealing, dipcoating. |
| JAN–P–116 | Packaging and packing for overseas shipment—Preservation, methods of. |
| JAN–P–117 | Packaging and packing for overseas shipment—Bags, interior packaging. |
| JAN–P–120 | Packaging and packing for overseas shipment—Cartons, folding, paperboard. |
| JAN–P–125 | Packaging and packing for overseas shipment—Barrier-materials, waterproof, flexible. |
| JAN–P–127 | Packaging and packing for overseas shipment—Tape; adhesive, pressure-sensitive, water resistant. |

| | |
|---|---|
| JAN–P–128 | Packaging and packing for overseas shipment—Tape; water-resistant, gummed. |
| JAN–P–130 | Packaging and packing for overseas shipment—Barrier-material; utility, noncorrosive, paper. |
| JAN–P–131 | Packaging and packing for overseas shipment—Barrier-material; moisture-vaporproof, flexible. |
| JAN–P–132 | Packaging and packing for overseas shipment—Crates; unsheathed, wood; nailed (for maximum net load of 2,500 pounds). |
| JAN–P–133 | Packaging and packing for overseas shipment—Boxes, set-up, paperboard. |
| JAN–P–140 | Packaging and packing for overseas shipment—Adhesives, water-resistant, case-liner. |

### 2. U. S. Army Specifications

| | |
|---|---|
| 100–2E | Marking shipments by contractors (and Signal Corps Supplement thereto). |

### 3. Signal Corps Instructions

| | |
|---|---|
| 720–7 | Standard Pack. |
| 720–14 | Depot Marking Manual. |
| 726–15 | Marking of Interior Containers. (For Signal Corps Equipment). |

### 4. Painting and Preserving

| | |
|---|---|
| SB 11–76 | Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment. |
| TB SIG 13 | Moistureproofing and Fungiproofing Signal Corps Equipment. |
| TB SIG 66 | Winter Maintenance of Signal Equipment. |
| TB SIG 72 | Tropical Maintenance of Ground Signal Equipment. |
| TB SIG 75 | Desert Maintenance of Ground Signal Equipment. |
| TB SIG 123 | Preventive Maintenance Practices for Ground Signal Equipment. |

### 5. Supply Publication

| | |
|---|---|
| SB 11–47 | Preparation and Submission of Requisitions for Signal Corps Supplies. |

# APPENDIX III

## IDENTIFICATION TABLE OF PARTS FOR TRANSMISSION MEASURING SET TS-568/FT

*Note.* The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite a T/O&E, T/A, T/BA, SIG 7–8–10, SIG 10, list of allowances of expendable material, or other authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7 & 8–TS–568/FT. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1, Introduction and Index.

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| | TEST SET, telephone: Army-Navy type TS-568/FT; furniture steel case with baked aluminum finish; over-all dimen with cover closed 13 11/32" lg x 11¼" h (incl handle) x 7 23/32" d; operating range 180 to 4000 cps; fungus resistant; WECo part/spec No. D-124544 noise analyzer attachment. | Used with Transmission Measuring Set TS-559/FT to measure harmonic components of telephone circuit noise resulting from neighboring power lines, and the corresponding components present in the current and voltage wave of power circuits. | 3F4316.3 |
| C-1 | CAPACITOR, variable: air dielectric; plate meshing type; single section; 45 μμf to 1275 μμf; SLC characteristic; .030" air gap; 5⅛" lg x 4⅛" wd x 3⅜" h (excluding shaft) with plates fully extended; WECo part/spec No. KS-8391. | Determines the resonant frequency of the tuned circuit. | 3DA1-275V |
| C-2 | CAPACITOR, decade: range 0 to .01 μf; accuracy ±.6%; 4⅞" h x 3½" thk over-all; rotary switch adjustment; two solder lug term marked "1" and "2" for capacitor, and two solder lug term marked "G1" and "G2" for ground connections; c/o WECo No. 184A switch; Nos. BR38, BR39, BR40, and BR41 capacitors; WECo No. 77A capacitor assembly (less knob). | Varies frequency range of tuned circuits in steps of .001 μf. | 3F1810-2.1 |
| C-3 | CAPACITOR, decade: range 0 to .1 μf; accuracy ±¼%; 4⅞" lg x 3½" wd x 3½" thk over-all dimen; rotary switch adjustment; two solder lug term marked "1" and "2" for capacitor, and two solder lug term marked "G1" and "G2" for ground connections; c/o WECo Nos. BR42, BR43, BR44, and BR45 capacitors; WECo No. 77B capacitor assembly (less knob). | Varies frequency range of tuned circuits in steps of .01 μf. | 3F1810-2 |

| | | | |
|---|---|---|---|
| C–4, C–5, C–6 | CAPACITOR, fixed: paper; 2.10 μf min, 2.16 μf max; 200 vdcw; hermetically sealed metal can; over-all 3½" h x 1½" wd x 31/32" thk; two solder lug term on top; mts with WECo No. 24 bracket; WECo No. 139 QB capacitor. | Together with L–2 forms 60-cycle shunt. | 3DB2E16–3 |
| | DIAL: c/o Kurz-Kasch knob No. S–309–64 and WECo No. P–387640 dial; knob 1⅝" diam x ¾" d; aluminum alloy dial (black background) 3.0" OD x ½" ID x .064" thk; 101 lines equally spaced around 180° on outer edge, marked in ⅛" h characters 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100; WECo part/dwg No. P–387641. | Control for capacitor C–1 | 2Z3723–157 |
| | DIAL: molded black bakelite; push-on type; engraved "001MF"; on skirt marked 0 to 10 incl; WECo part/dwg No. P–386933. | Control for capacitor C–2 | 2Z3723–158 |
| | DIAL: molded black bakelite; push-on type; engraved "01MF"; on skirt marked 0 to 10 incl; WECo part/dwg No. P–386934. | Control for capacitor C–3 | 2Z3723–160 |
| | HOLDER: c/o clear cellulose acetate sheet; 16.0" lg x 11 11/16" wd; bound with leather; WECo part/dwg No. P–386930. | Chart holder | 2Z5042–71 |
| | KNOB: round; black phenol plastic; WECo part/spec KS–13642; list 13. | Controls for D–1 and D–2 | 2Z5822–384 |
| E–1, E–2, E–3, E–4, E–5, E–6. | POST, binding: straight type; black molded bakelite; Eby No. 46 "Admiral" type. | IN, C, OUT, and GND connections (fig. 1). | 3Z737–12.1 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| L–1 | REACTOR: audio reactor; dual wnd; (1–2), (3–4) 3800 turns each of #33 AWG "HF" wire; min 8.12 hy, max 8.28 hy; 340 ohms DC resistance; 500 v AC test; toroidal molybdenum permalloy dust core potted in a rectangular metal can; magnetic shielding; WECo No. D–158355 retardation coil. | Together with C–1, C–2, and C–3 forms tuned circuit. | 3C575T–7 |
| L–2, L–3 | REACTOR: audio reactor; dual wnd; (1–2), (3–4) 1400 turns each of #33 AWG "HF" wire; min 1.090 hy, max 1.110 hy; 75 ohms DC resistance; 500 v AC test; toroidal molybdenum permalloy dust core potted in a rectangular metal can; magnetic shielding; WECo No. D–158356 retardation coil. | Together with C–4, C–5, and C–6 forms 60-cycle shunt. | 3C575T–6 |
| CR–1 | RECTIFIER, metallic: copper oxide; input 4.5 v RMS, output v at .008 amp DC in ambient temp of 105° F; rectangular, 1⅞" lg x 1⅝" wd x ¾" d over-all; moisture resistant; WECo No. D–98914 varistor. | For temperature compensation in calibration circuit. | 3H4956–61 |
| R–1, R–2, R–3, R–4. | RESISTOR, fixed: WW; 38,200 ohms min, 40,800 ohms max; 1½ w; wnd of 2300 turns of #42 DC resistance wire; noninductive; No. 36 CE resistance. | Together provide 100,000-ohm line-to-ground shunt for noise-to-ground measurements. | 3Z6640–100 |
| R–5 | RESISTOR, fixed: WW; 6.6 ohms ±1%; ¼ w; JAN type RB51B6R600F. | Bypass path for unwanted frequencies. | 3RB2–6600 |
| R–6 | RESISTOR, fixed: composition; 2000 ohms ±5%; ½ w; JAN type RC20BF202J. | Control resistor in feedback calibrating circuit. | 3RC20BF202J |
| R–7 | RESISTOR, fixed: WW; 5000 ohms ±1%; ¼ w; JAN type RB51B50000F. | Controls resistor in feedback calibrating circuit. | 3RB5–5000 |

| | | | |
|---|---|---|---|
| R–8 | RESISTOR, variable: JAN type RV4AUSA103E, 2 w, ±10%. | Adjusts feedback calibrating circuit | 3RV41025 |
| R–9 | RESISTOR, variable: JAN type RA20A1SA103AK. | Gain control | 3RA7506 |
| S–1 | SWITCH, rotary: 2 pole, 5 position, 2 sections; contacts will make and break ¾ amp at 24 v DC; two stationary stops 120° apart; WECo part/spec KS–8394 switch. | Varies frequency range of tuned circuits by changing value of inductance across tuning capacitors. | 3Z9825–66.123 |
| S–2 | SWITCH, rotary: 2 pole, 5 position, 4 sections; contacts will make and break ¾ amp at 24 v DC; contacts of third section nonshorting, sections one, two, and four are shorting type; locking action; two stationary stops 180° apart; WECo part/spec KS–8395 switch. | Varies internal connections for different calibrating and measuring operations. | 3Z9825–66.124 |
| T–1, T–2 | TRANSFORMER, AF: line type; impedance ratio 600 to 6.0 ohms between secondary wnd (3–4) (5–6) and primary wnd (1–2); shell type coil with chromate permalloy core potted in a sheet metal case; DC (1–2) .45 ohm and (3–4) (5–6) in series 47 ohms; range 60 to 10,000 cps; electrostatic and electromagnetic shielding; 6 solder lug term; WECo No. 140C repeating coil. | Input and output transformers. Provide current step-up. | 2Z9637.125 |

# APPENDIX IV

## GLOSSARY

*Dba.* Sometimes, to compare the relative effects of noise currents on different receivers, it is necessary to adjust the calibration constants used with the noise measuring sets in such a manner that all noise results are on the same basis; namely, in terms of a quantity which is indicative of the potential acoustic interfering effect of the noise-frequency weighted energy which is measured electrically on a particular circuit or receiver. This quantity is the dba. Thus, equal values of dba, as determined from measurements (using the proper frequency weightings) across a 144, a 557, or an HA1 receiver, denote approximately equal interfering effects. Similarly, equal values of dba of live noise using the F1A or 144 line weighting denote substantially equal interfering effects for conversations using station sets with these two receivers.

*Harmonic.* A multiple of a fundamental frequency. The harmonics of 60 cycles per second, for example, are 120, 180, 240, 300, etc., cycles per second.

*I.T.* This is the product of the rms current and the current TIF.

*Im.* Metallic circuit current.

*Kv.T.* This is the product of the rms voltage in kilovolts and voltage TIF.

*Mca.* Microampere.

*Noise-longitudinal.* A longitudinal circuit is a circuit formed by each telephone wire or a group of telephone wires acting as a single conductor with return through the earth or other remote conductor. The inductive effect of a power circuit on a longitudinal circuit is the induction of current in the longitudinal circuit which constitutes noise-longitudinal. If any unbalances exist in the telephone wires constituting the longitudinal circuit, currents will flow between the unbalanced wires creating noise-metallic.

*Noise-metallic.* Current that produces noise in actual wire pairs, open wire, cable, or otherwise. A metallic circuit, as applied to telephone circuits, commonly means a side, phantom, or nonphantomed circuit. Noise-metallic is the noise current at any given point in such a metallic circuit when that circuit is terminated at that point in an impedance approximately equal to the characteristic impedance of the circuit. Ordinarily, noise-metallic is measured with the distant end also terminated in approximately the

characteristic impedance of the circuit. Noise-metallic is the resultant of two components: first, direct metallic induction, and second, metallic currents resulting from the action of noise-longitudinal on any series or shunt unbalance which may be present in the exposed telephone line or extension thereof or in apparatus connected to the exposed line.

*Noise-to-ground.* This is the noise current from a telephone pair connected together and to ground through 100,000 ohms.

*TIF.* The telephone influence factor (TIF) of a voltage or current wave is the ratio of the square root of the sum of the squares of the weighted rms values of all the sine wave components (fundamental and harmonic) to the rms value of the wave.

*Varistor.* A special resistive material whose resistance decreases with an increase in temperature.

*Weighting.* In deriving methods for estimating and measuring noise, one of the necessary factors is a knowledge of the relative importance of noise components at different frequencies in the noise range. That is, the results of a measurement must be weighted. Weighting curves and tables have been determined for various receivers on the basis of articulation and judgment tests. In the case of TS–559/FT, networks which accomplish the weighting automatically are incorporated as part of the circuit. Thus, all strictly quantitative results on the amplitude of noise frequencies on a telephone circuit are automatically adjusted in terms of their interfering effect.

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